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A Search for Evolutionary Changes in Planetary Nuclei: A Continuation

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ABSTRACT

This report summarizes the final results of an IUE investigation to search for signs of evolutionary changes in high-mass central stars of planetary nuclei, as evidenced by UV-optical fading over the lifetime of the satellite. The program is a continuation of an earlier investigation, expanding the target list to include more types of hot central stars and to obtain more spectra of previously observed stars.

In order to compare the IUE fluxes of a central star obtained over a more-than-ten-year timespan, several steps were necessary, including reprocessing of very early spectra and correction for the sensitivity degradation of the SWP camera over time. The results indicate that while a few stars appear to have diminished UV fluxes compared to earlier IUE observations, the evidence for this is less than overwhelming due to the sparseness of the data. Those stars which emerge from this study as viable candidates for having faded are the cooler Of-type stars (O6f-O7f), i.e., those for which the change in spectral energy with increasing temperature is greatest.

The report describes the data analysis steps and discusses the uncertainties in both the data and in the resulting fading rates. Estimates of stellar mass based on theoretical evolutionary rates are also provided.

Keywords: planetary nebulae central stars; UV spectra; IUE; stellar masses; stellar evolution; post-AGB evolution

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I. Introduction

This report describes the final results of a continued IUE investigation (IUE Program PNOSH) by Sara R. Heap (PI; NASA/GSFC) and Bruce Altner (Co-I; ARC). The program was designed to search for signs of evolutionary changes in high-mass central stars of planetary nuclei, as evidenced by UV-optical fading over the lifetime of the IUE. We expected to be able to detect fading in central stars with masses of about $0.75M_{\odot}$ and higher, a result which would have two important consequences. First, it would provide the most direct test of evolutionary models for post-AGB objects. Second, it would enable us to determine independent estimates of stellar mass, and thus provide additional constraints for spectroscopic analysis.

A. Previous Work

The program was a continuation of an earlier investigation, expanding the target list to include more types of hot central stars and obtaining more spectra of previously observed stars. Preliminary results of the first phase of this work have appeared in Heap (1992) and in Altner and Heap (1992).

B. Work for this Contract

The continuation of earlier work involved several tasks directed at measuring UV fading rates in central stars of planetary nebulae (CSPN): a) acquisition of additional IUE spectra; b) data reduction of new spectra and integration into the existing data set; c) evaluation of test cases and control samples for error estimation; results and interpretation for individual objects. Each of these components of the work shall be discussed in this report. Finally, the results were to be interpreted in the light of theoretical studies tying the rate of stellar evolution to the mass of the star.

II. New Observations

Spectroscopic theory suggests that stars showing strong He II 4686 emission, *i.e.*, the Wolf-Rayet and Of-type stars, are more massive and therefore should show detectable fading, so we expected such stars to be the best candidates. However, analysis of another of our program stars, NGC 6826 (O3f), revealed no evidence of fading. Hence, we decided to observe stars over a much wider range in temperature and spectral type than was our original plan. The hotter stars, for which a measurable fading is not expected, were included as controls, both to test the theory and to help evaluate the instrumental response. The sample includes stars which are known to be irregular or pulsational variables, as well as non-variable stars. Variability in a central star for which fading has been observed clearly increases the uncertainty of the derived mass, by an amount which depends on the number of observations.

In Table 1 we list the program stars and their low dispersion SWP spectra analyzed in this paper. A complete search of the IUE archive shows that many other low dispersion SWP spectra exist for this sample of stars. Some of these were rejected for obvious reasons, such as saturated data or use of the small aperture, while others were rejected only after careful scrutiny of the

original observing scripts revealed pointing errors, multiple exposures, or uncertain exposure times. Most of the observations were taken either in the early IUE episodes (1978–1980) or as part of our current program (1989–1993), with very few in between. The explanation for this nearly bimodal distribution of epochs is simply that once the bright central stars had been observed, few researchers saw the need to go back to them. Since no one expected IUE to last as long as it has, the idea of a decade-long monitoring program may have seemed out of reach to proposers in the middle years. The unfortunate end result is that many of our fading determinations are based on one or two early observations (which had to be reprocessed) and one or two very recent observations (which had to be corrected for camera sensitivity degradation). We shall have more to say about these and other data reduction steps in the next section. Thirty-five new spectra of 16 stars, obtained as part of this contract, were acquired during 10 IUE shifts in November, 1992 through April, 1993.

III. Data Reduction

In order to compare the IUE fluxes of a central star obtained over a more-than-ten-year timespan, several steps were necessary:

1. Reprocessing of observations prior to November 1981, to ensure uniformity of spectral image processing algorithms. Here we used the SDPS system described in Feggans et al., (1988) applied to the raw images. We verified that this yields almost the identical result as obtained by reprocessing under IUESIPS, while being far more convenient for us to use.
2. Flux extraction. For each spectrum we determined the width and location of the peak of the spatially-resolved profile, extracting the fluxes from the line-by-line file. In all cases the LBL profiles were consistent with a point source, but the centering within the aperture was found to vary from image to image by several lines. Hence, we used the default point-source extraction parameters, in conjunction with the measured shifts, to extract the spectra. We found that this gave us more consistent results than widening the extraction slit, as one does for extended sources.
3. Correction for the known rate of sensitivity degradation in the SWP camera. We used a smoothed version of Garhart's (1992) degradation curve, applied to the absolutely calibrated, merged-extracted low dispersion files. Data processed to this point were saved as IDL 'save' files, which contain the image header and the wavelength, flux, and epsilon vectors.

In order to determine the rate of fading over time, we developed IDL routines which first retrieve the stored spectra, bin the data, and then fit a straight line to the binned fluxes when plotted versus date. The fading rate is expressed as the slope of the fitted line. The binning process gives zero weight to flagged data points such as reseau and extrapolated-ITF pixels and the bins themselves were chosen to avoid nebular emission lines and P-Cygni features. In some stars, this required rather narrow bands, whereas much broader bins could be employed in the case of featureless central stars such as NGC 1360.

IV. Error Estimation

One must take into account the repeatability of a camera in order to ascertain the credibility of variations in spectral lines or continuum levels. That is, if the variation of a measured feature is less than the measured repeatability error, the results are meaningless. — (Garhart and Nichols 1995)

The latest in a series of measurements of repeatability in IUE observations, processed using the NEWSIPS algorithms, confirms the results of earlier studies, namely, that the flux level reproducibility in the SWP camera is approximately 2-3% over most of the wavelength range, even for low signal (40% level) exposures (Garhart and Nichols 1995).

The causes of this observational uncertainty are not well understood at this time, but it seems to be a fairly stable result and a true estimate of the best agreement one could hope for between repeated measurements of the same object taken under the same conditions. However, it is incorrect to assume from this that differences between observations greater than the 2-3% level necessarily represent a real variation. The reason for this is the statistical nature of the derived minimum uncertainty: it is based on many observations. Examining differences between individual pairs of observations reveals that the spread can sometimes be significantly larger.

A. A Test Case

Since our fading study dealt with a very small number of epochs, for reasons noted above, we wanted to derive a clear sense of what the actual *point-to-point* variations of an otherwise unchanging star look like. Furthermore, we also wanted to see what kind of "fading" rates we could derive for such a star in order to compare this to what we had measured for the CSPN in the study sample. This would also serve the very useful purpose of checking that our data processing steps, including the sensitivity correction procedure, did what they were supposed to do.

For this purpose we obtained a large set (29, which is large by the standards of this work) of low dispersion spectra of the IUE standard star BD +75° 325, *i.e.*, a star not expected to change, and processed them using exactly the same steps described in Section III. The dispersion about the mean in each 100 Å-wide interval was approximately 2%, while the spread of values (maximum – minimum) was about three times as large. With such a large sample of points (29) the mean error is probably a fair estimate of the measurement uncertainty, so linear fits were performed assuming a 2% uncertainty in each measurement. The resulting fits all had slopes very close to zero, as expected (BD +75° 325 was one of the 5 stars used by Garhardt 1992 to determine the sensitivity correction). This is shown in Figure 1. The scatter about the line is about 2% in all cases, as demonstrated by Gaussian fits to histograms of the normalized data (Figure 2).

B. Correlated Errors

Because the magnitude of the effect we wish to measure from the data is, except for the most massive central stars conceivable, not much larger than the observational uncertainty intrinsic to the detector, it is crucial that we be able to separate the random variations from those occurring in the star itself. The latter, of course, may be associated with periodic pulsations, binary eclipses, or other such causes instead of or in addition to the changes due to post-AGB evolution. A discussion of these effects is beyond the scope of this report, but we do have a method whereby we might identify how much uncorrelated variation is present in the data set. What remains is then correlated variability, part of which may be instrumental, and part of which may be due to UV-optical fading (we assume here that the temperature changes associated with the CSPN's evolution may be large enough to cause a slight decrease in the UV-optical flux, but still too small to create measurable changes in the spectral index).

One signature of a non-color-dependent variation is if the errors in separate bandpasses of each spectrum are *correlated*. That is, if the flux in a bin at 1350 Å is 3% larger than the mean (at that wavelength), then most likely the flux in a bin at 1850 Å will be about 3% larger than the mean in that bin. Significant deviations from this behavior, *e.g.*, uncorrelated errors, are most likely not instrumental in origin, at least in the sense of being an observation of the same object under identical conditions.

To test this idea we have defined a quantity, $\chi(k, j)$, which is the relative error of an observation at wavelength k at epoch j . Appendix A provides a short mathematical derivation which shows, that for small errors, $\chi(k, j)$, is related to the natural log of the ratio of the flux at wavelength k and time $t(j)$ divided by the time averaged flux at wavelength k , which are both known quantities. If we then compare the fluxes in two wavebands for the whole ensemble of points in a sample, we may find both correlated and uncorrelated errors, the latter arising from the cross terms in the covariance matrix.

We show this in Figure 3 for the points in the BD +75° 325 sample, for the 1450 ± 50 Å and for 1850 ± 50 Å passbands. The measured dispersion in magnitude here is about 2.3%, consistent with both what we have derived above and with the reproducibility studies of Garhart and Nichols (1995) and others throughout the years. However, this sample also shows a small color variation, about 1%). From this we conclude that the IUE's uncertainty in flux measurements is about 2%, and variations significantly larger than this, might be real, while its uncertainty in measuring the spectral index half of that, so significant variations in the color term might point to either real variability or serve as a warning that there are other problems with the data (*e.g.*, scattered light due to the infamous "streak").

C. Discussion of the Measurements

In Figures 4 we show the results of the fading analysis (i.e., "light curves") along with plots of the spectra (minimum, maximum, and average) and the error-correlation plots described above, for the majority of the program stars. Table 2 summarizes these results.

It is clear from both the figures and the table that few stars in this full sample can be said to have demonstrated unambiguous evidence of fading over the timespans involved. Many stars which, like BD +75° 325, are controls, show very steady behavior, with only small slopes. Examples are the hotter subdwarfs and wDs, such as NGC 7009, NGC 1360, NGC 7293. They also demonstrate similar dispersions in both the correlated and uncorrelated errors, as does BD +75° 325. These are excellent controls which show that the one can indeed select out those stars which do not vary at all, using our techniques.

Some cases demonstrate very odd behavior indeed. NGC 6543 shows a tremendous variation; this is clearly not due to the effect we are looking for here. Unfortunately, the time sampling does not give a very good measure of the slope of the changes in this star, if indeed the changes are linear.

The most interesting result of our study is that a very narrow subgroup of CSPN, the late-type Of stars (O6f-O7f) seem, as a class, to show the most direct evidence for fading. Examples are He 2-131, NGC 418, IC 4593, and NGC 2392. The slopes are large enough to be disallowed as being entirely due to instrumental effects, and the color terms of the uncorrelated errors are reasonable. Moreover, these stars are those for which the change in spectral energy with increasing temperature should be the largest, as demonstrated in Figure 5. This Figure shows that the stars in the temperature range 20,000 K to 35,000 K still show a significant rate of change of flux as the temperature increase, whereas the hotter stars do not (based on a blackbody flux distribution). Finally, the masses derived from these results are consistent with masses at the extreme high end of the CSPN mass range by either one of the two model calculations discussed below.

Unfortunately, the errors in the linear fits to the fading results are very large, as a result more of the poor sampling than of intrinsic uncertainties in the data themselves. This makes fine tuning of the slopes, and the masses derived from them, problematic. Taken together, all the evidence suggests that for the late Of-type stars fading may take place at the rate of 4-8% per decade, but it is not possible to give formal confidence limits to this result.

V. Interpretation of the Measurements

As first outlined by Paczynski (1971), a central star of a planetary nebula evolves off the asymptotic giant branch to higher temperatures as its hydrogen-rich envelope is reduced — from the inside by nuclear burning, and from the outside by mass-loss in a stellar wind. The timescale

for evolution is thus, $M_{\text{env}}/(dM_{\text{env}}/dt)$. Because M_{env} is much smaller, and dM/dt is much larger in the more massive central stars, their timescale for evolution is drastically shorter. The evolution of the interior is manifested at the surface by UV-optical fading, and it is this which forms the basis of our conversion between fading rate and stellar mass.

We used the spectral energy distributions of the Kurucz 1991 models to estimate the initial brightness of a star of some initial T_{eff} in a given wavelength band. The observed UV-optical fading, caused by the diminishing brightness in that bandpass as the star evolves, thus leads to an estimate of the present, hotter temperature. We interpolated within the hydrogen and helium-burning evolutionary sequences of Wood and Faulkner (1986) wherein the rate of change of temperature is given as a function of stellar mass, in order to transform the fading rates into stellar masses. A major uncertainty in our approach is the initial temperature of the CSPN, a somewhat elusive quantity for these objects. The uncertainties in the quoted masses include a 10% spread in the input initial temperature.

The null result for the hotter CSPN suggest two possible conclusions: either they are truly less massive than the later Of-type stars, or they are insensitive to our method in the spectral bandpasses of the SWP camera. The conclusion for the few stars which do show fading is on firmer ground, since this is a positive result: these stars have dimmed in the last decade or so by an amount much larger than can be explained by instrumental effects. If the cause is evolution along a post-AGB track, the rate of fading gives us firm upper limits to the stellar masses, which serves as an important constraint in evolutionary calculations.

The models of Wood and Faulkner (1986) yield mass estimates of 0.74 to 0.78 for fading rates between 4 and 8%, respectively, in the temperature range of the late Of-type stars. For the same observations, the models of Blöcker and Schönberner (1990) yield masses roughly 0.03 $M_{\odot}$ smaller. This result suggests that these stars are among the highest mass CSPN known.

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VII. Figure Captions

Figure 1: For purposes of comparison with "light curves" for the CSPN sample, here we show the results of applying our reduction steps to the series of SWP spectra of the IUE standard star BD +75° 325, in 100 Å-wide bins centered at 1450, 1650, 1750 and 1850 Å. Using 2% as the random error of an individual observation, we have performed linear fits of the normalized fluxes versus time in each bin. The resulting slopes are all very close to zero, as expected.

Figure 2: Although the slopes of the "fading" curves, dL/dt , are close to zero in Figure 1, the scatter is such that a similar measurement made among a randomly chosen subset of just a few points (2 to 6, typical of the sample numbers in our work), would be large indeed, and might be either positive or negative. In this series of histograms of normalized flux in the same four passbands as Figure 1, we superimpose a Gaussian curve as a representation of the distribution. The peak of the curve is given by $N\Delta x/2\sigma$, where Δx is the width of the histogram bins (0.005) and N is the number of observations. The values shown for σ in each bin were determined in the fitting process, and are all close to the expected value of 2%.

Figure 3: Correlated error plot for BD +75° 325, based on the discussion of Section IV B. Here we are plotting $\chi(k,j)$ for $k=1450 \pm 50\text{Å}$ on the abscissa and for $k=1850 \pm 50\text{Å}$ on the ordinate, for all epochs. The dispersion of the points in magnitude (correlated errors) is 2.2% while the color term (uncorrelated errors) is 1.1%. Elliptical contours are superimposed, with semi-major and semi-minor axes of 1, 2, and 3 times the dispersions in magnitude, and color, respectively. In this case, since the star is known not to vary in spectral type, we expect all the variation to be in the magnitude term. However, there appears to be a 1% variation in color as well, when measured in these two bands.

Figure 4: Representative spectra, error plots, and fading diagrams in two bandpasses for the stars of our extended sample. In each of the many pages representing Figure 4, the upper left panel shows three spectral traces for the given star: the average over all epochs, the minimum, and the maximum. Also superimposed on these are vertical lines showing the bandpasses which were used in the other figures. The upper right panel shows the mean errors in both bands, as described in the caption for Figure 3. Within the 1σ ellipse is a diagonal line whose length represents the 2% (correlated) uncertainty associated with IUE measurements. The lower panels show the binned data points and the slopes associated with the straight line fits to them.

Figure 5: Plot of the temperature dependence of the Planck function. In the top panel we show the integrated flux within the IUE SWP wavelength interval (1200--2000 Å). In the bottom panel we show the derivate, dF/dT_{BB} , of the integrated flux. This demonstrates that, for a blackbody at least, that stars hotter than about 40,000 K will not significantly diminish in UV intensity no matter how hot they get (the peak of their Planck distributions is already outside the IUE range). This result is quite consistent with our finding that only the cooler stars show evidence of fading when measured with our technique.

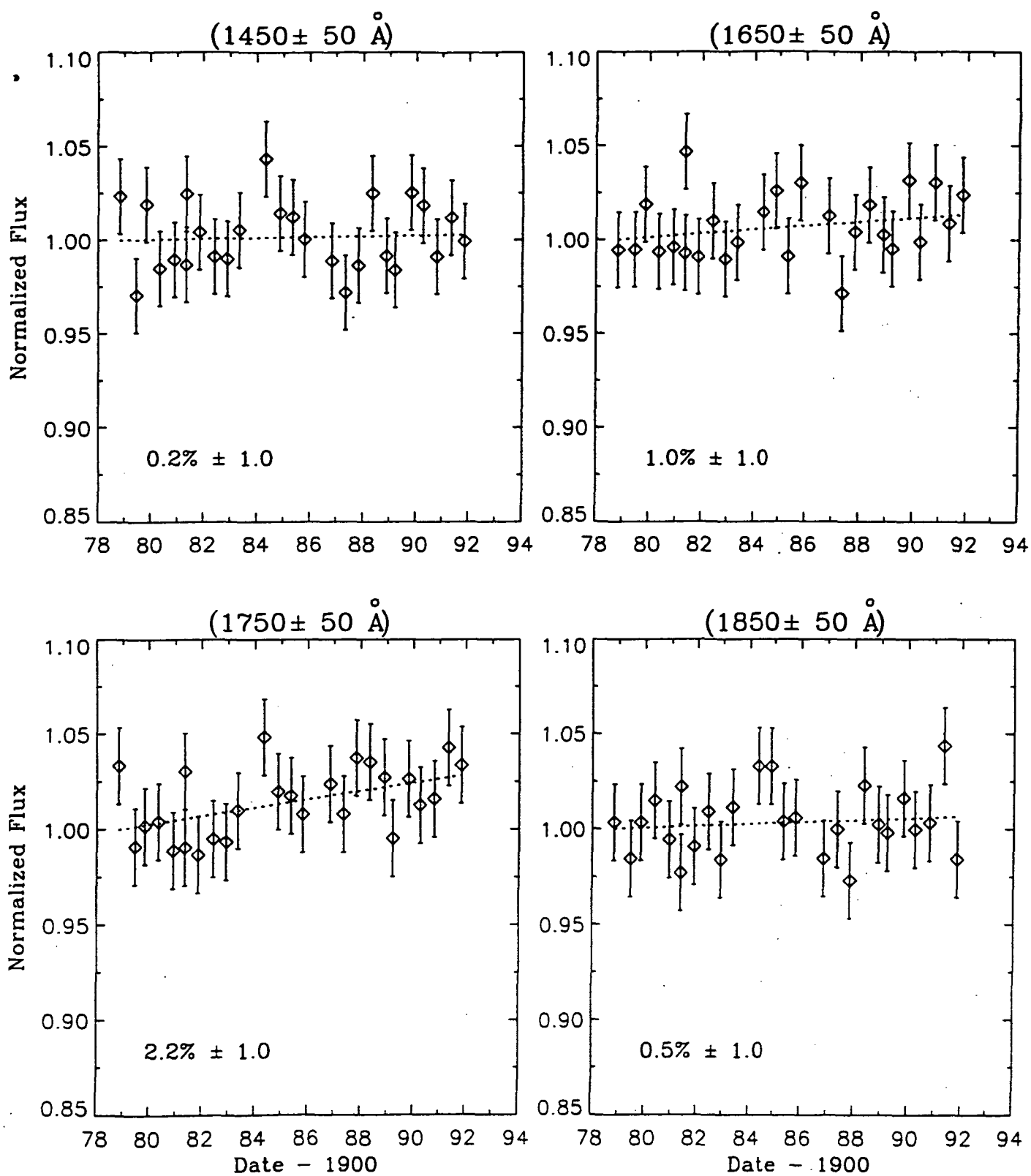


Figure 1

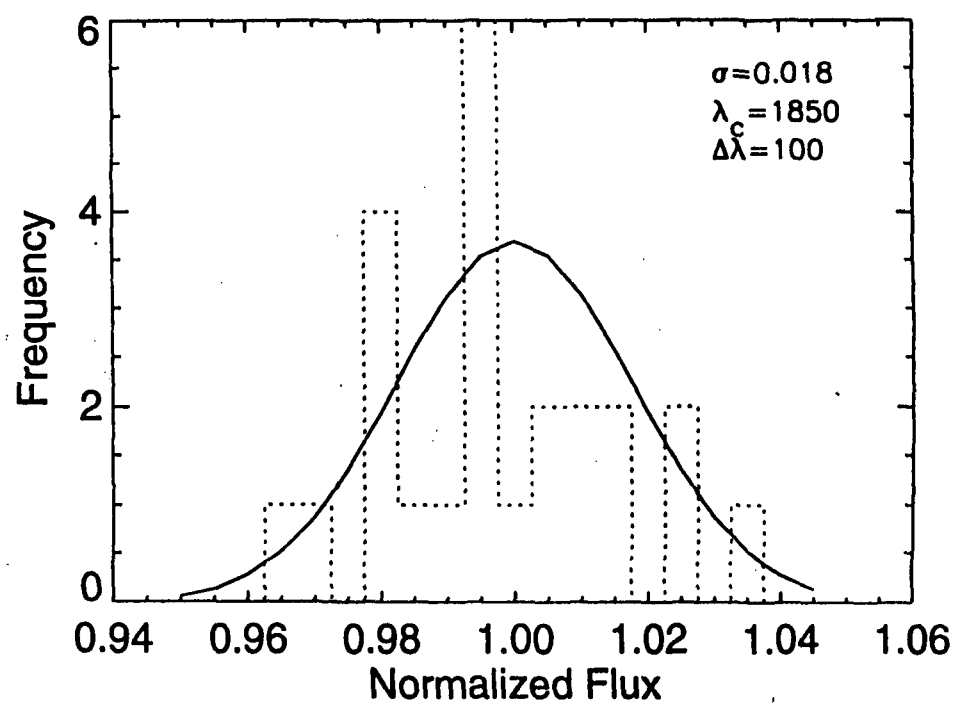
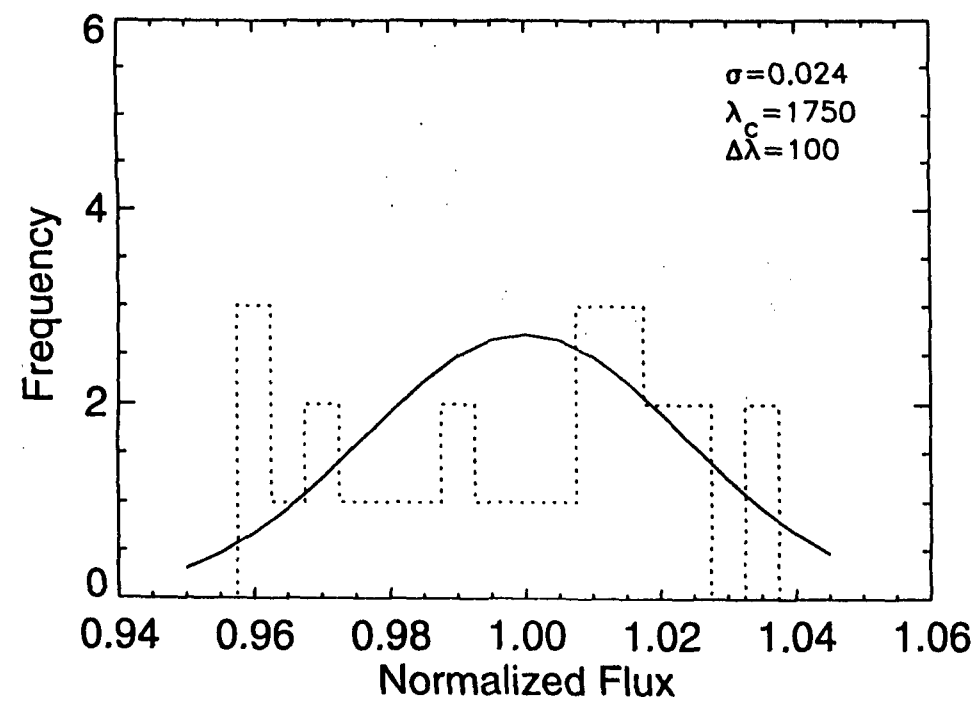
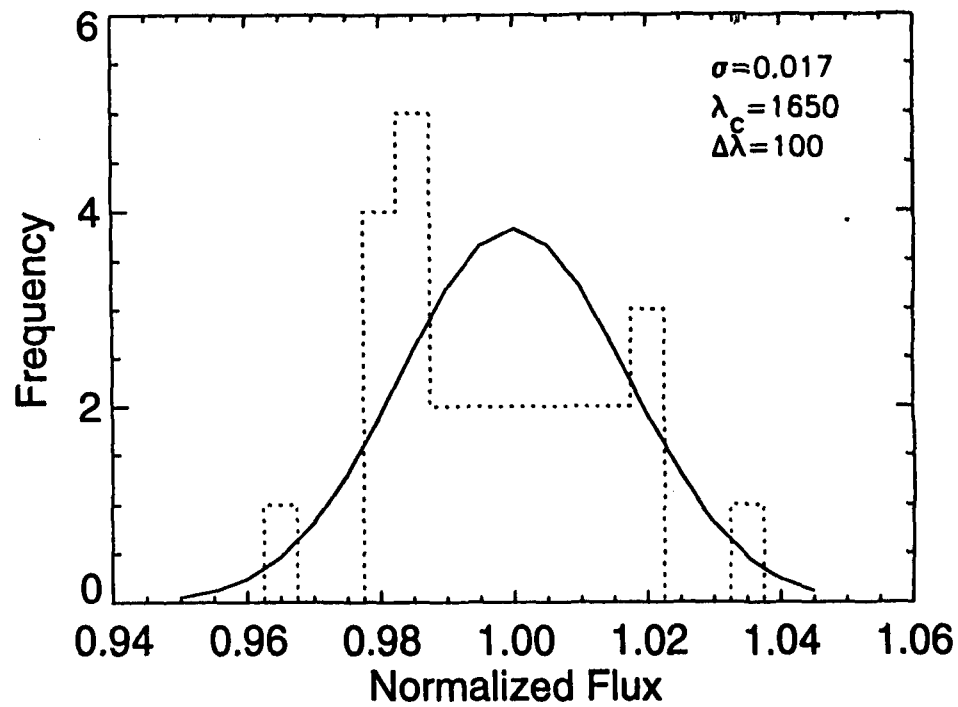
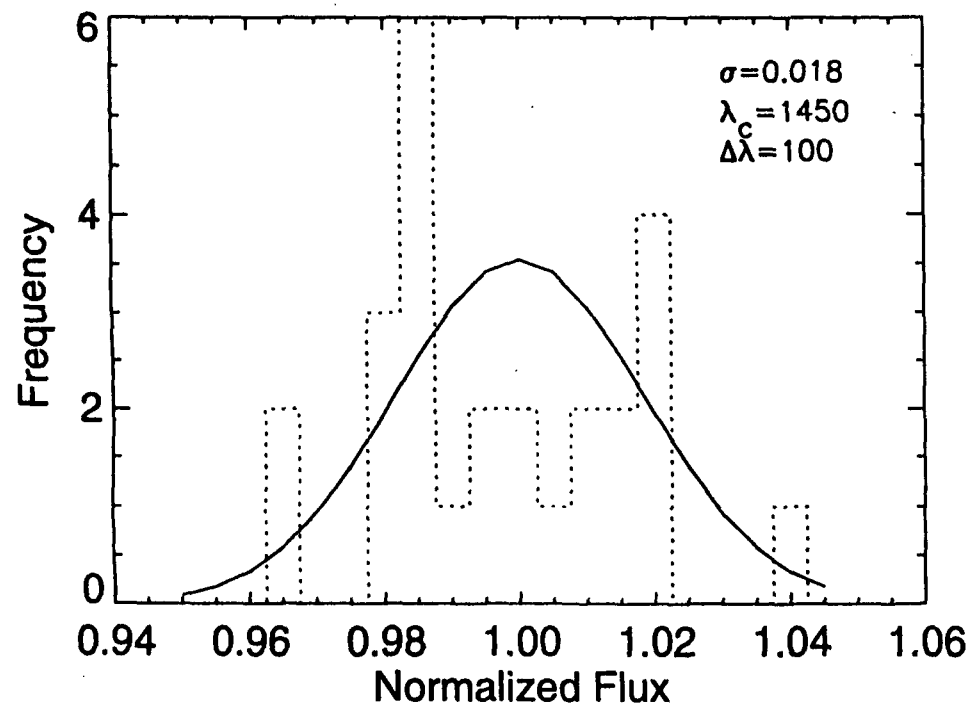


Figure 2

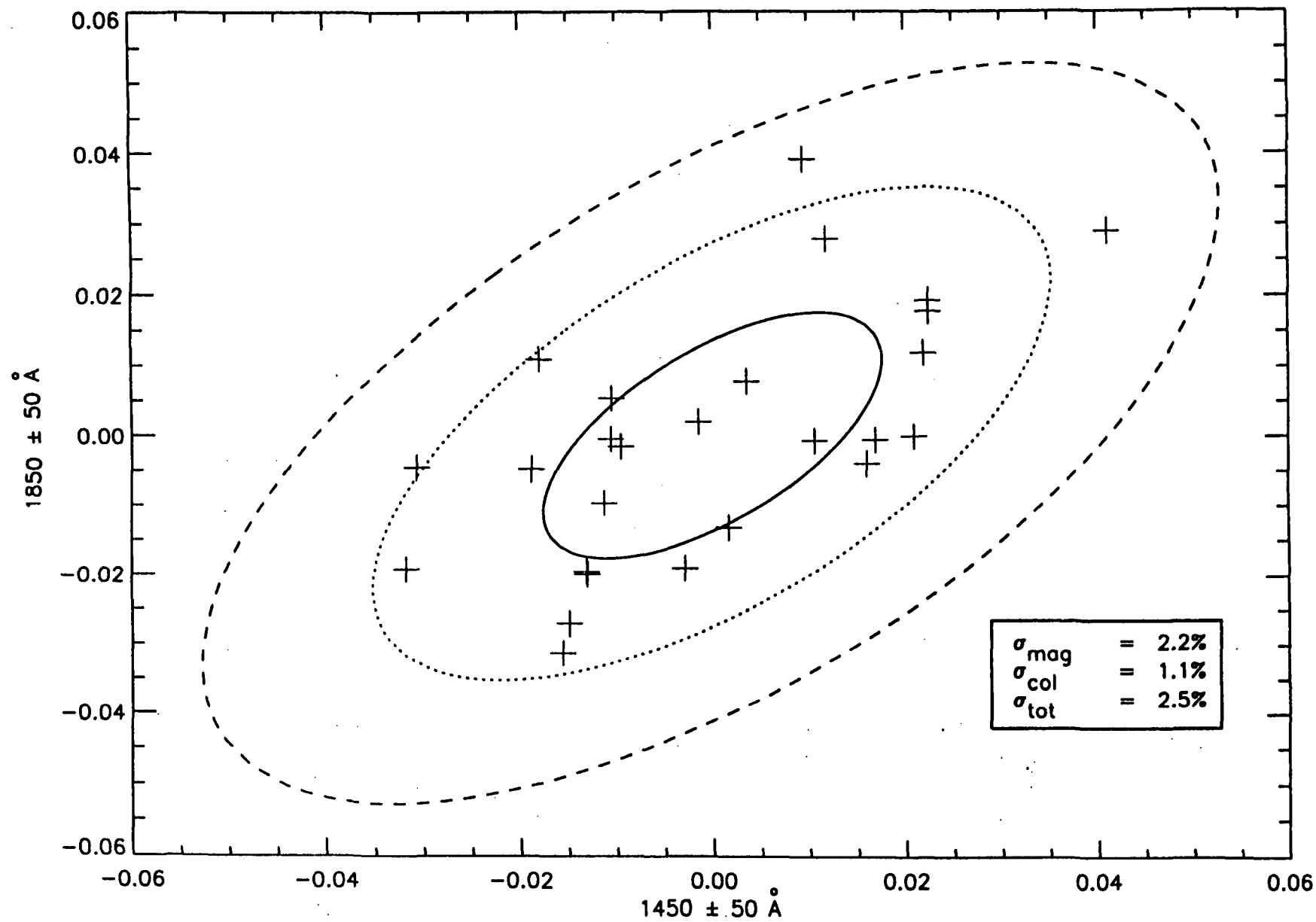
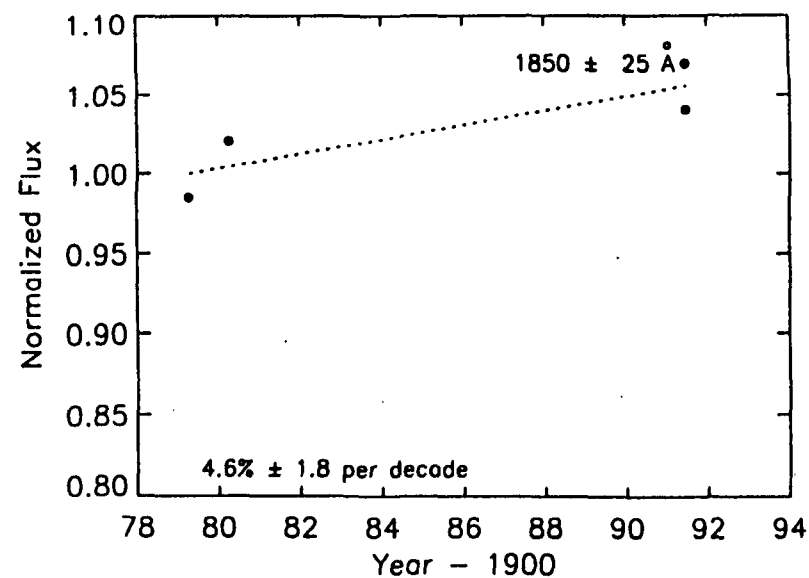
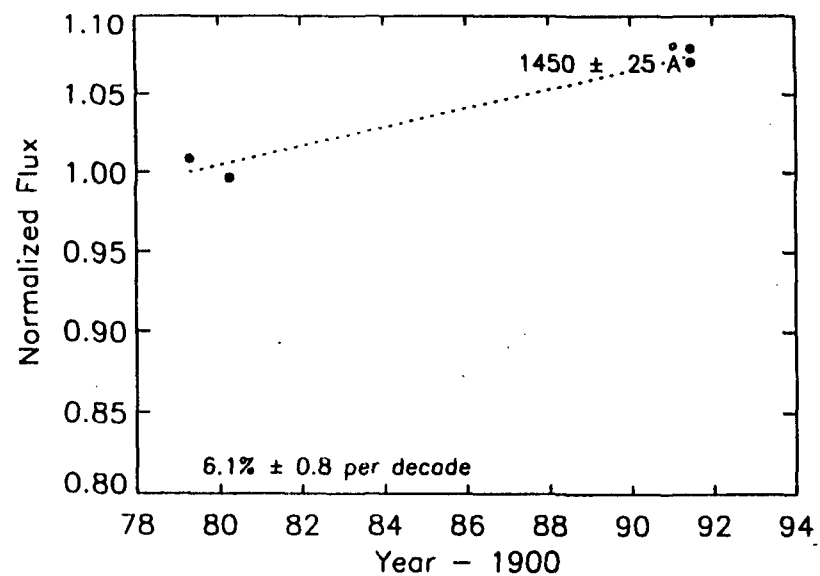
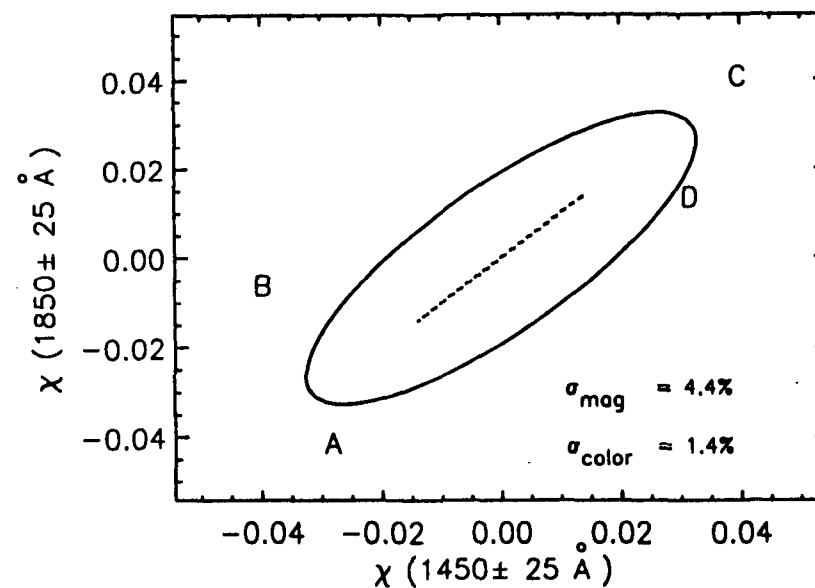
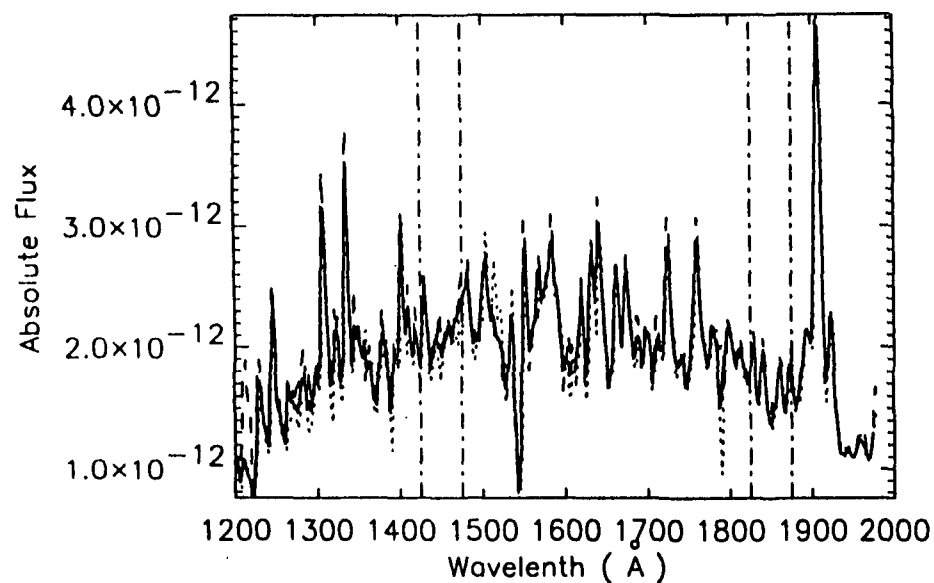


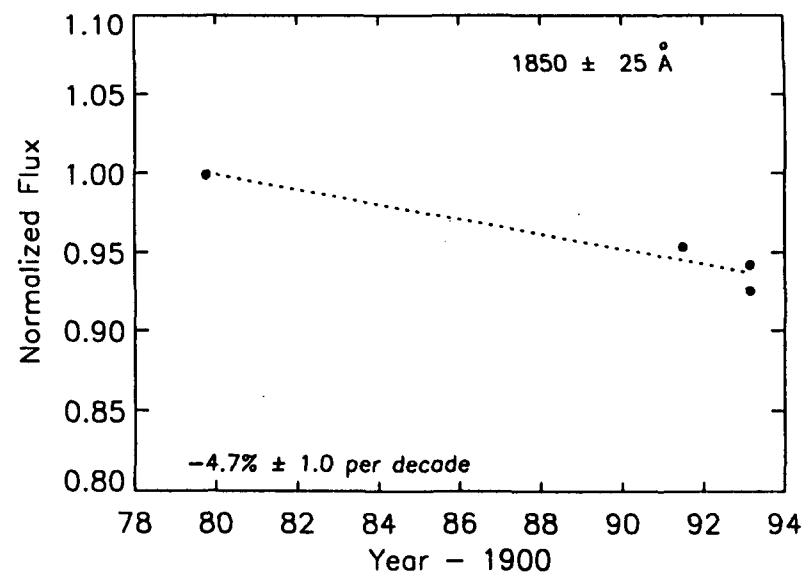
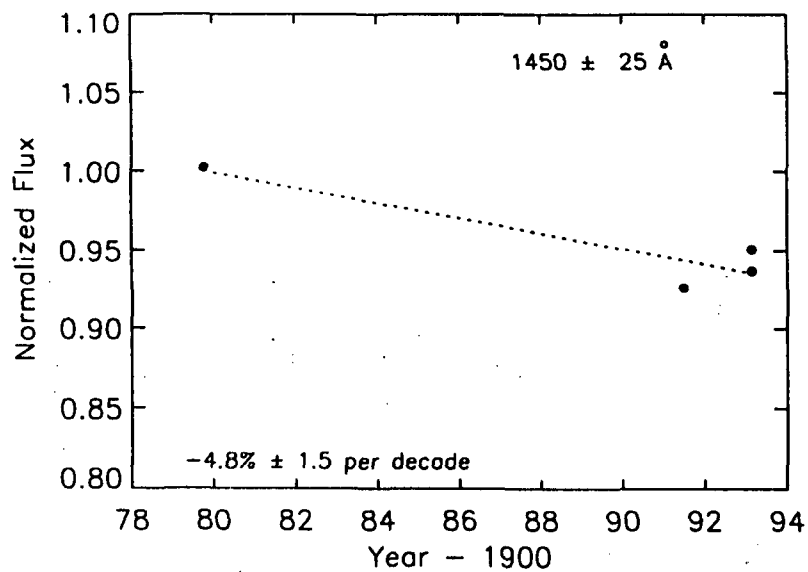
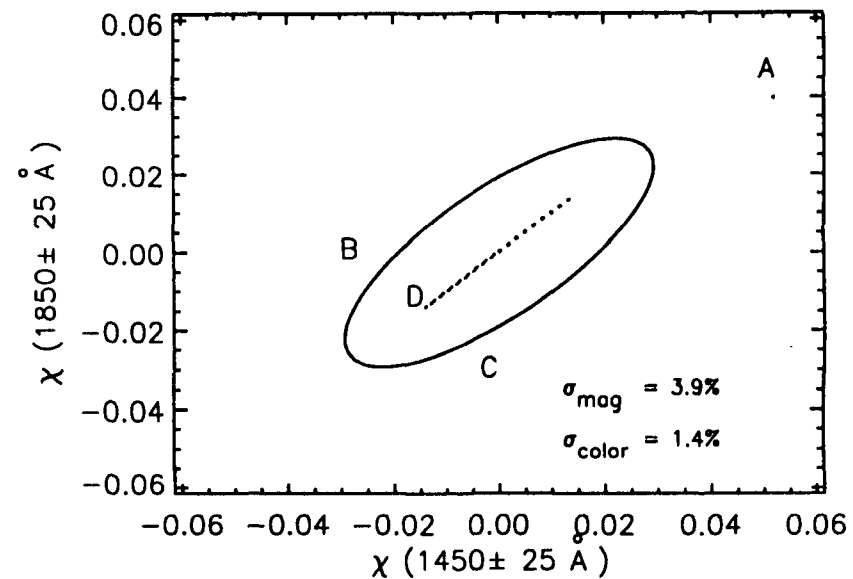
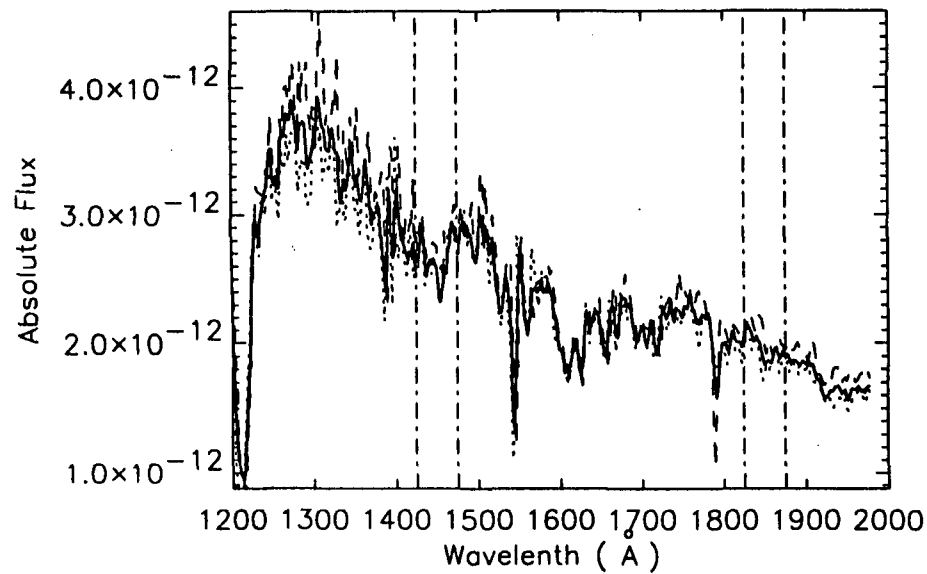
Figure 3

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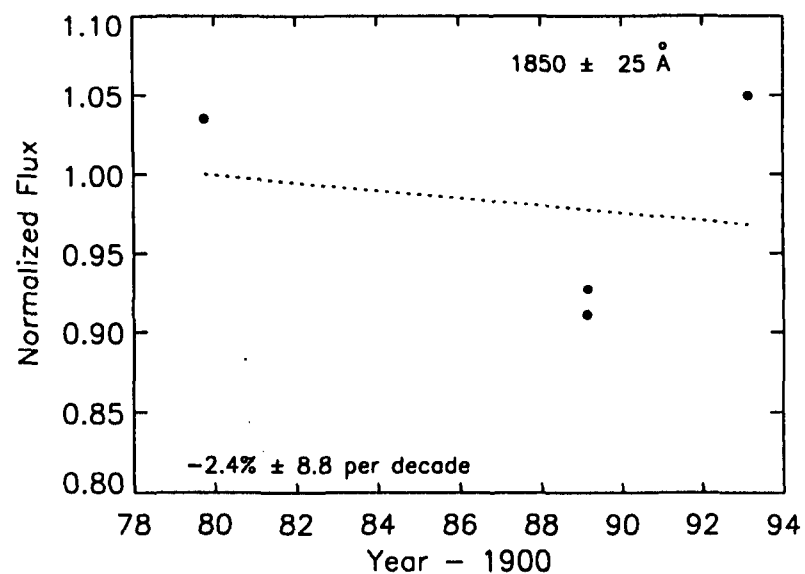
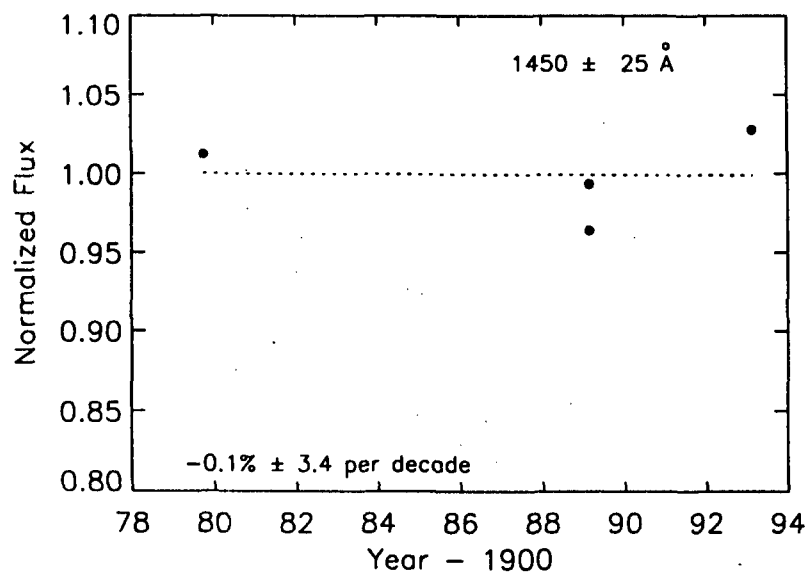
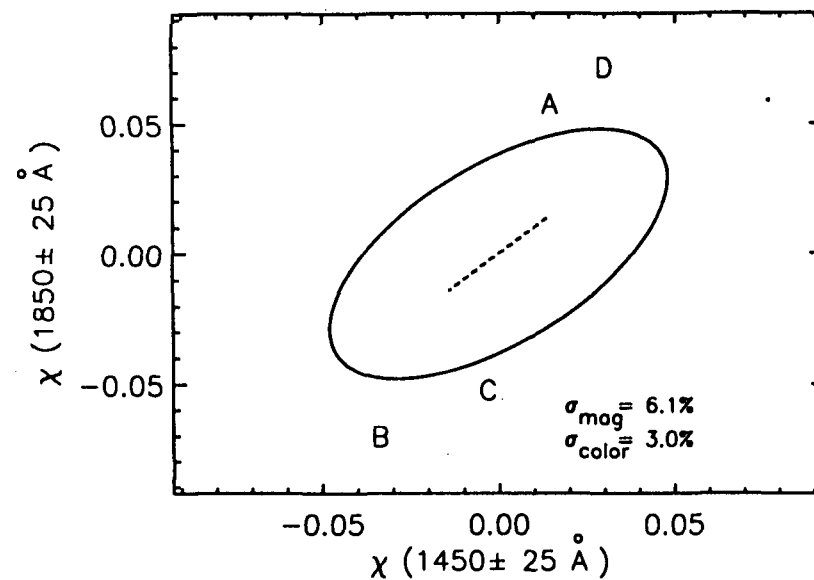
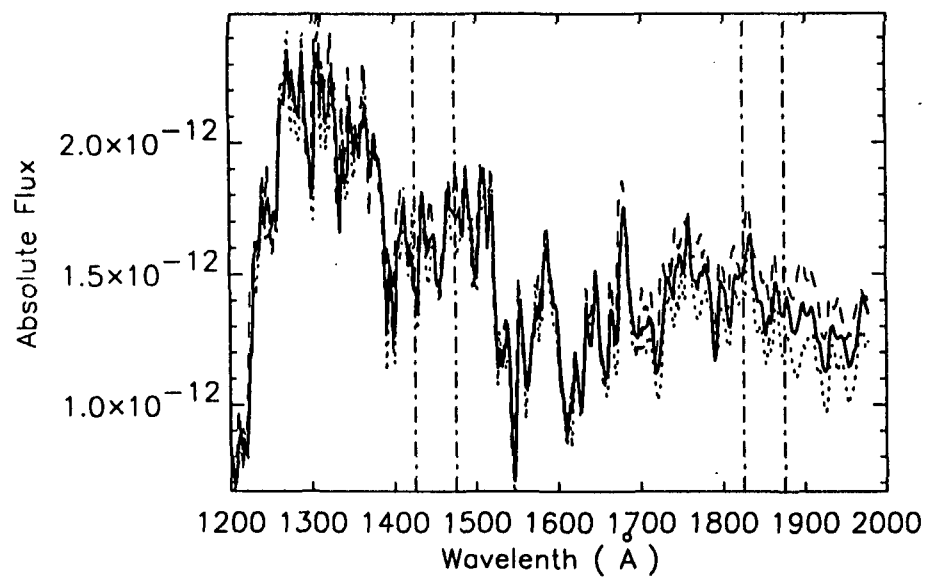


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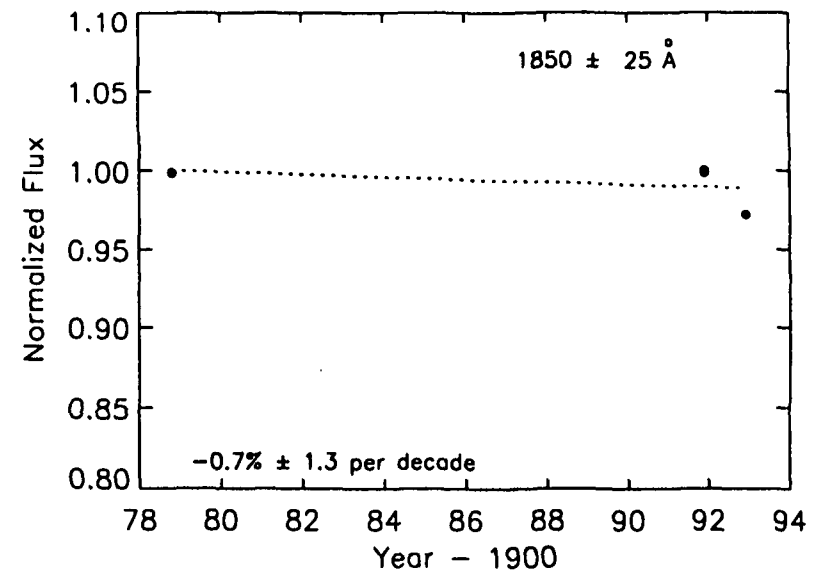
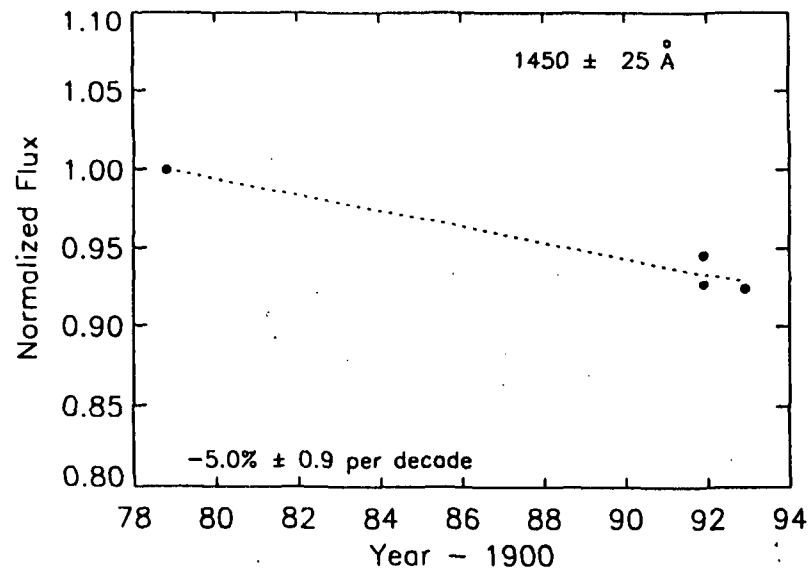
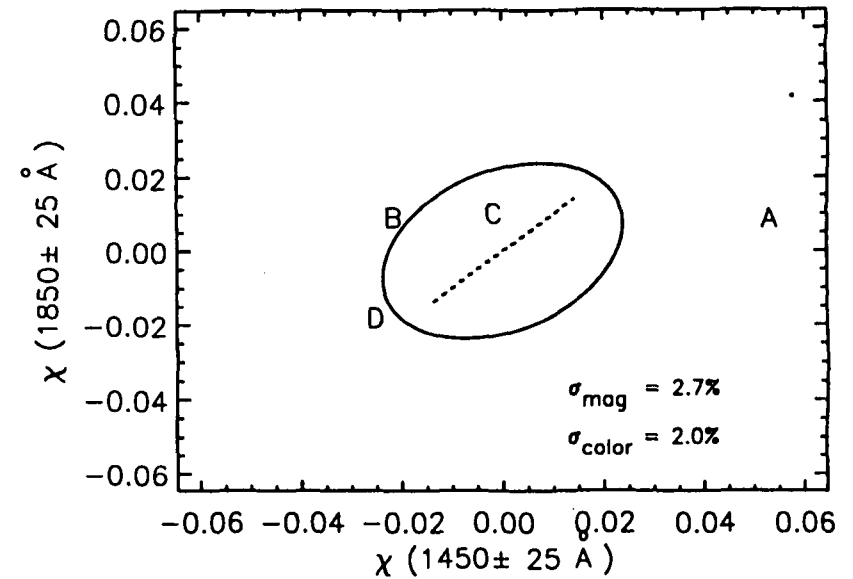
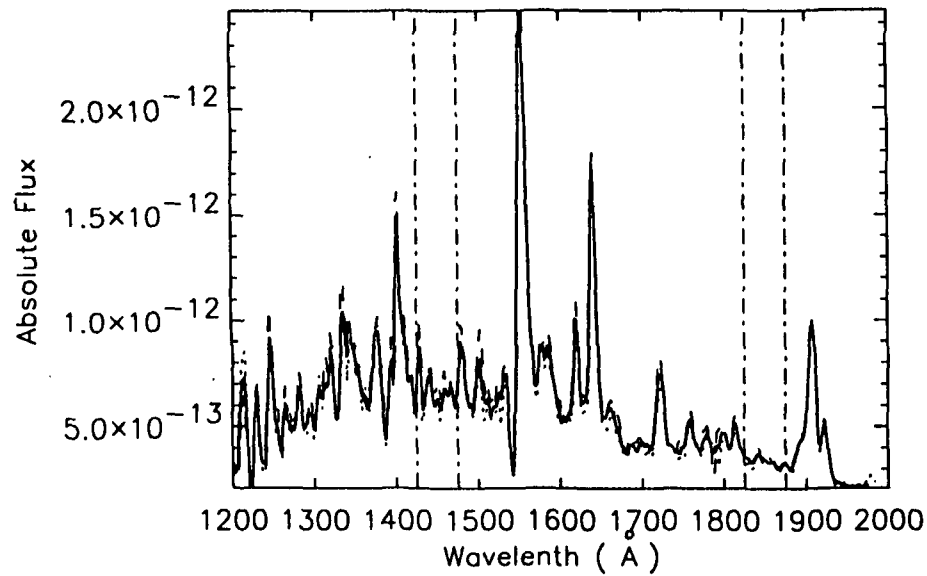
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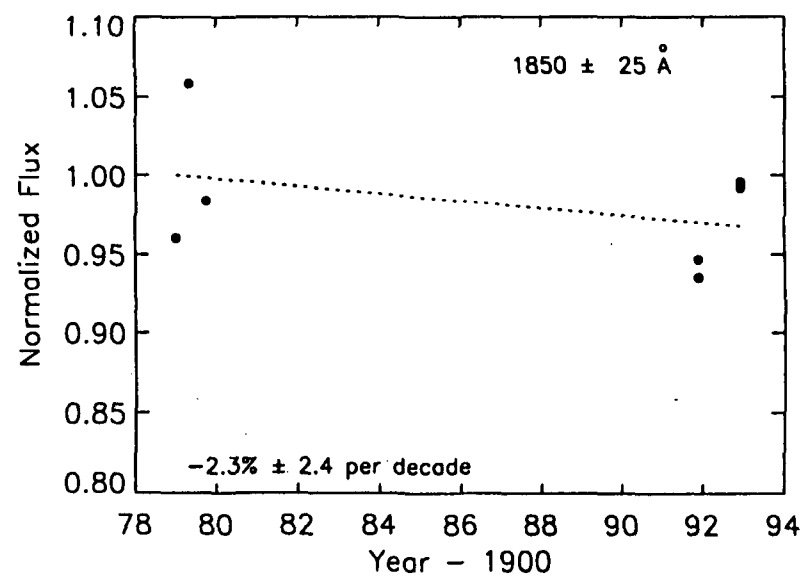
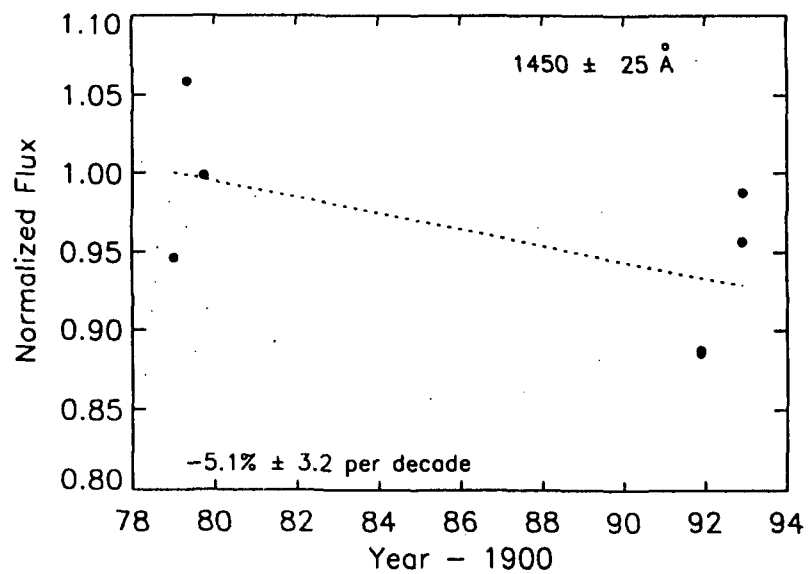
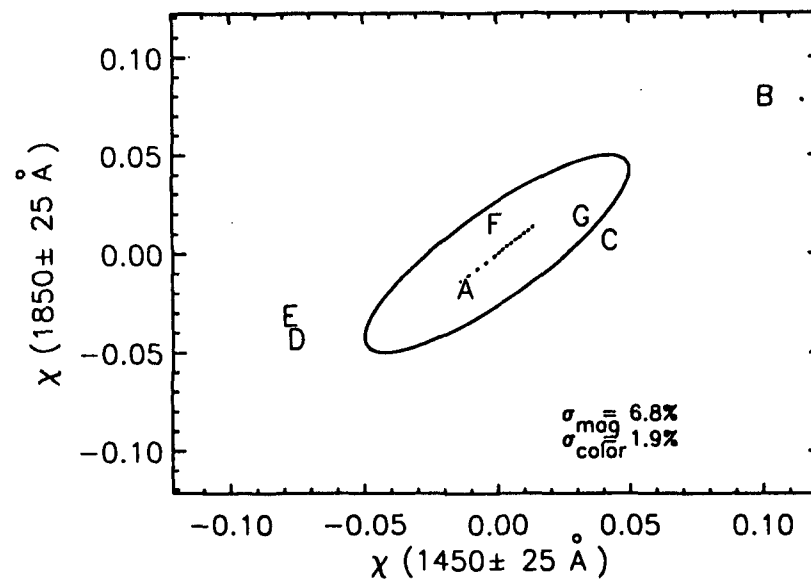
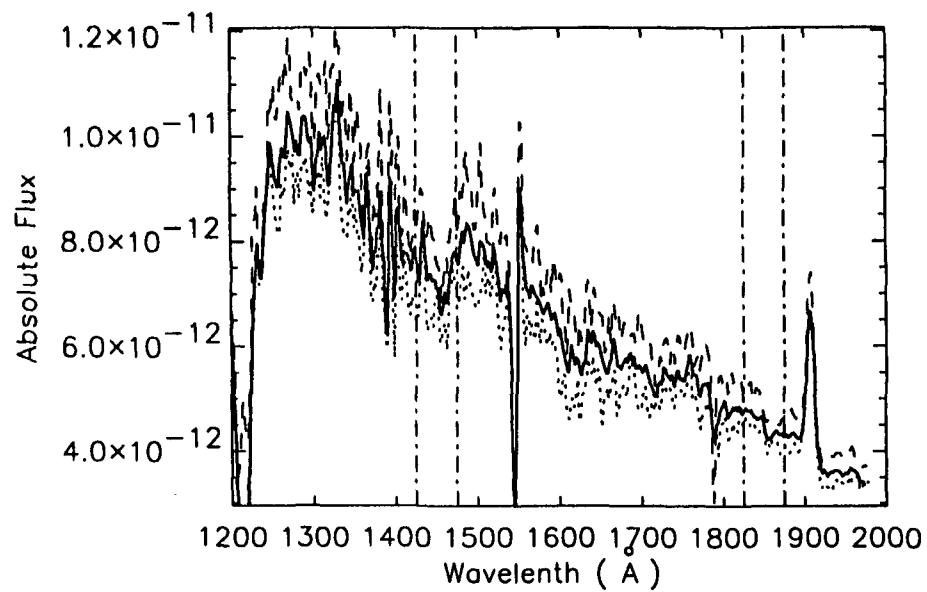


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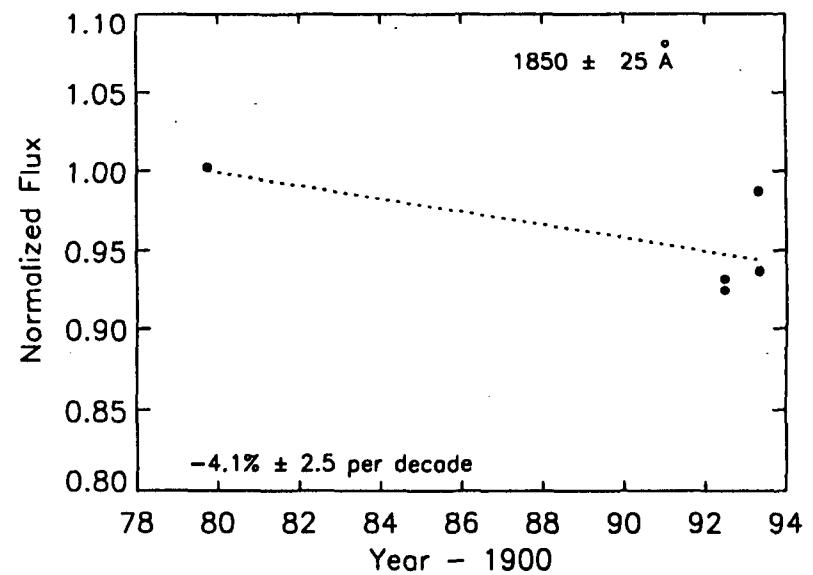
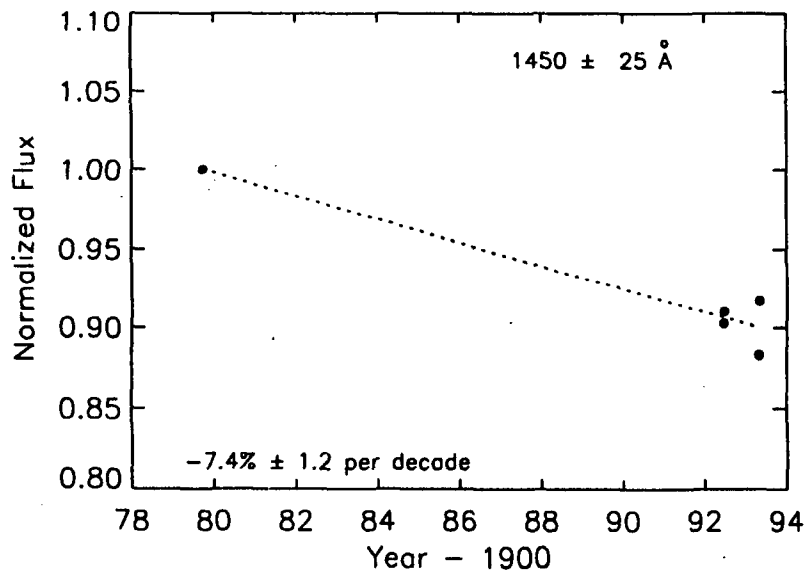
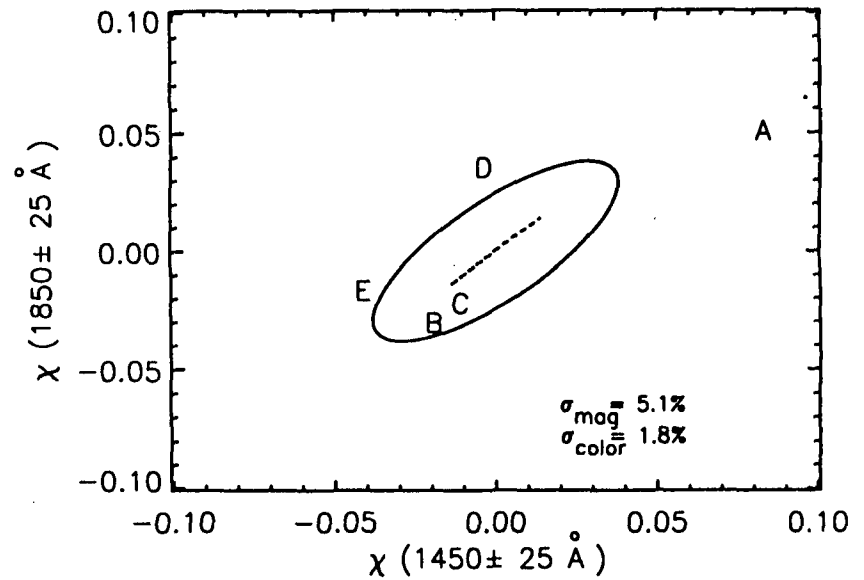
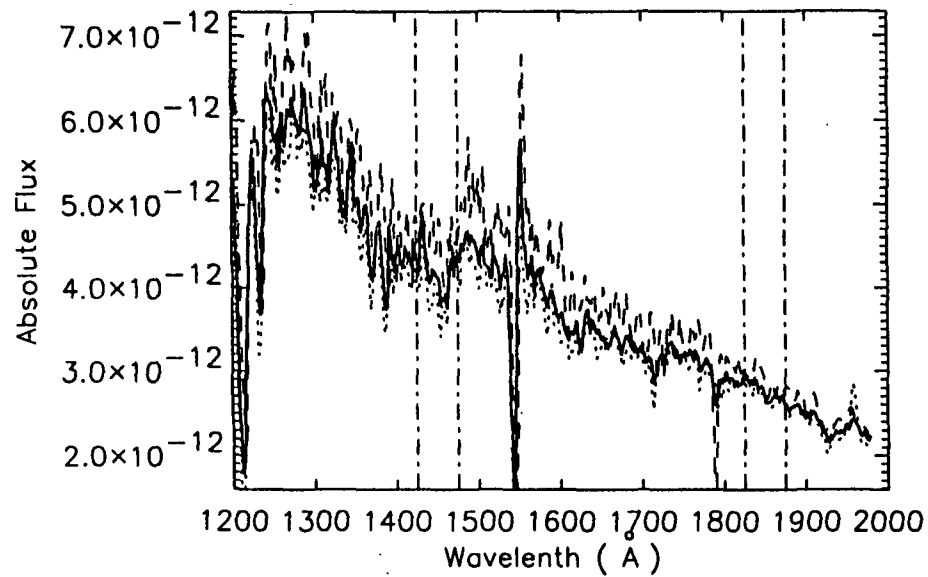


NGC 40

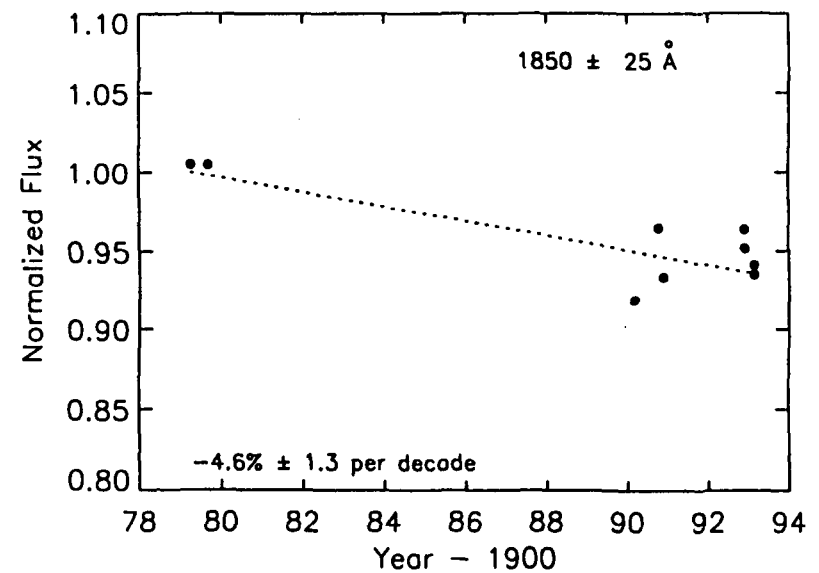
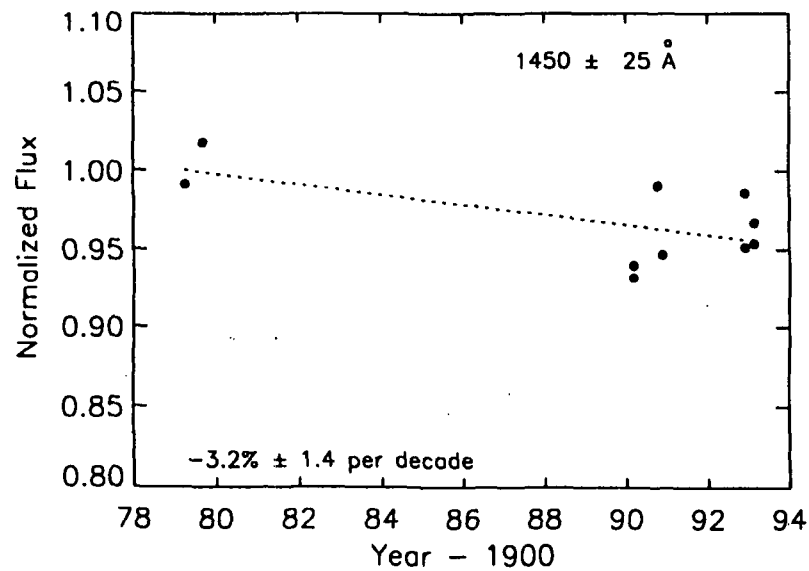
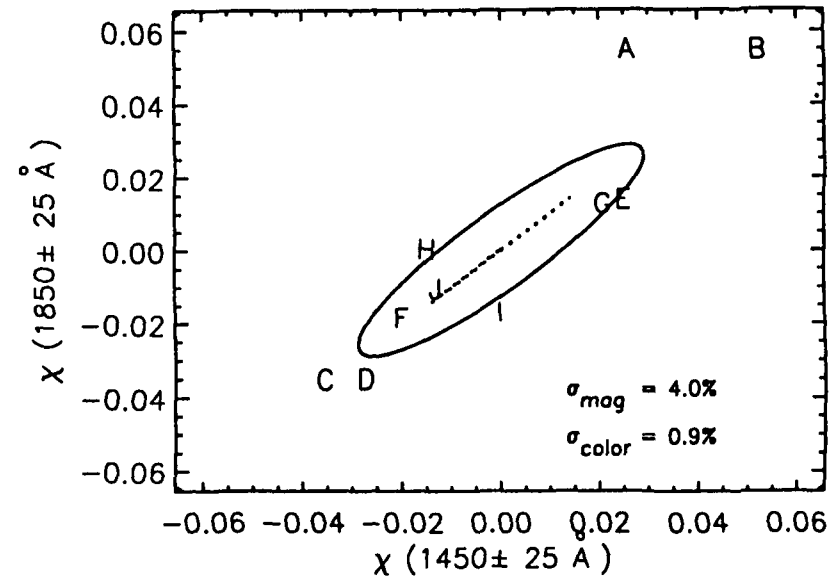
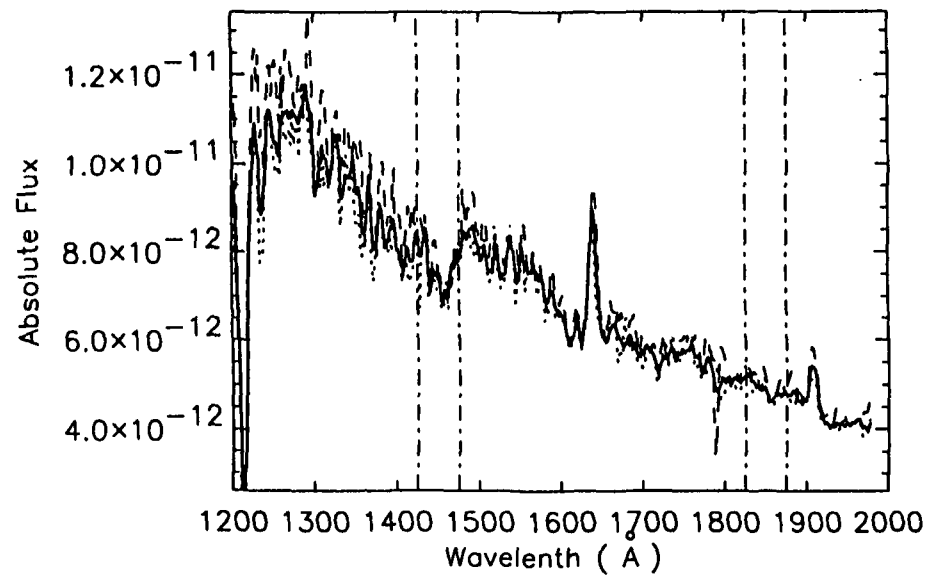




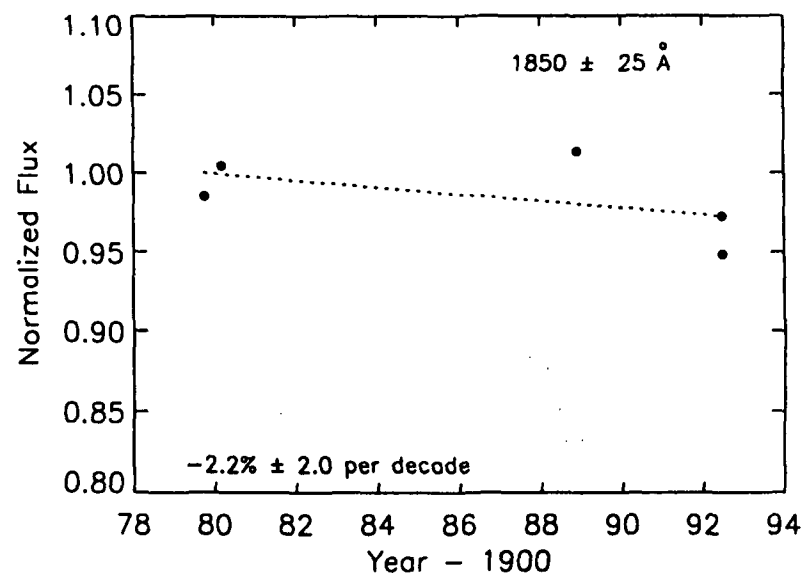
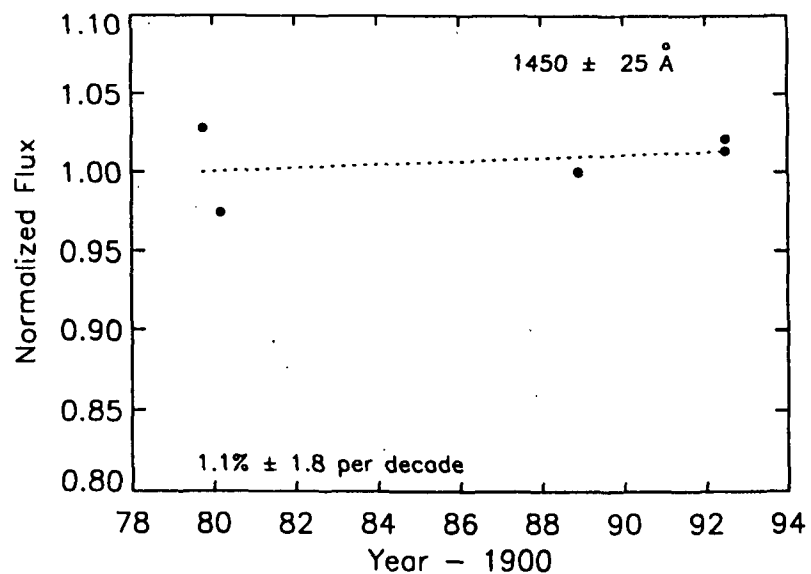
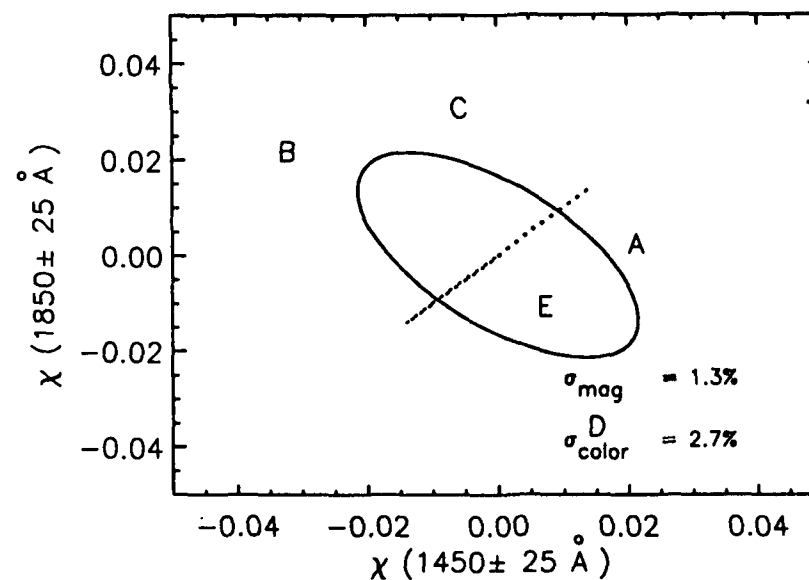
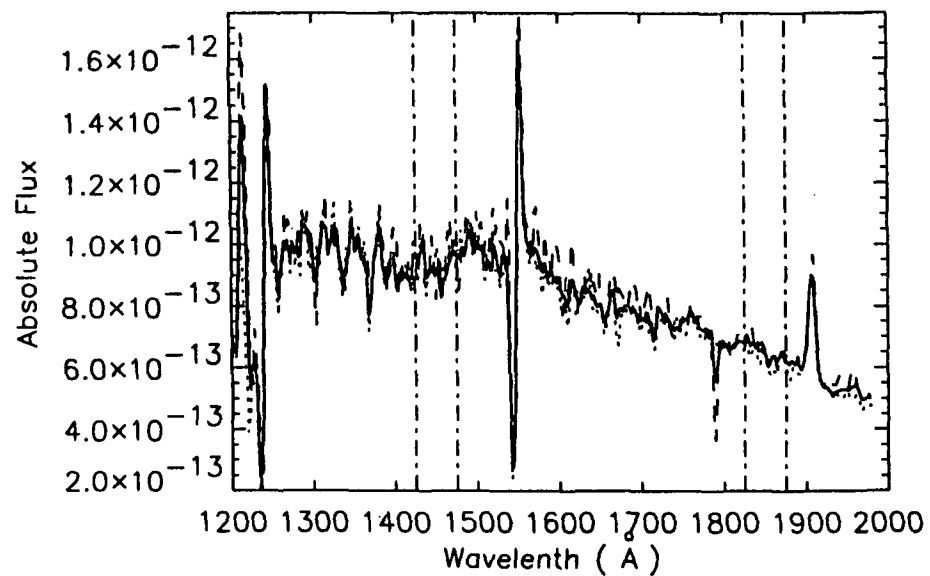
IC 4593



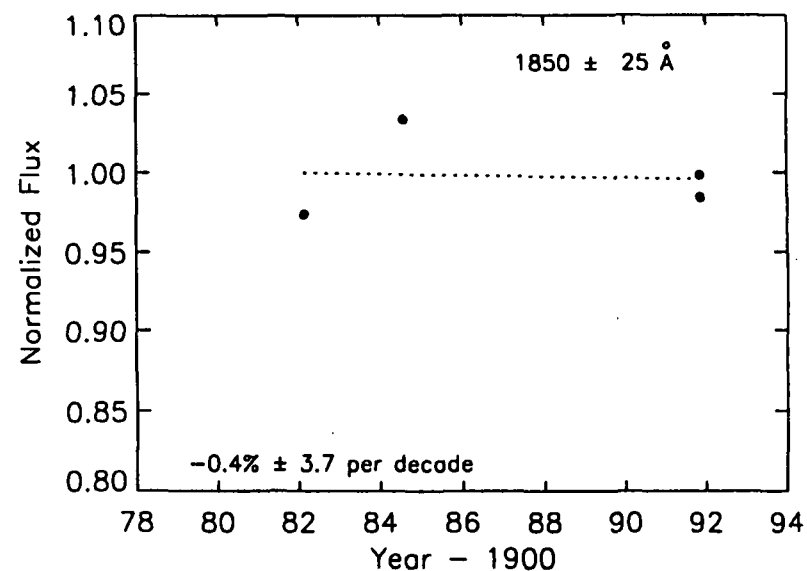
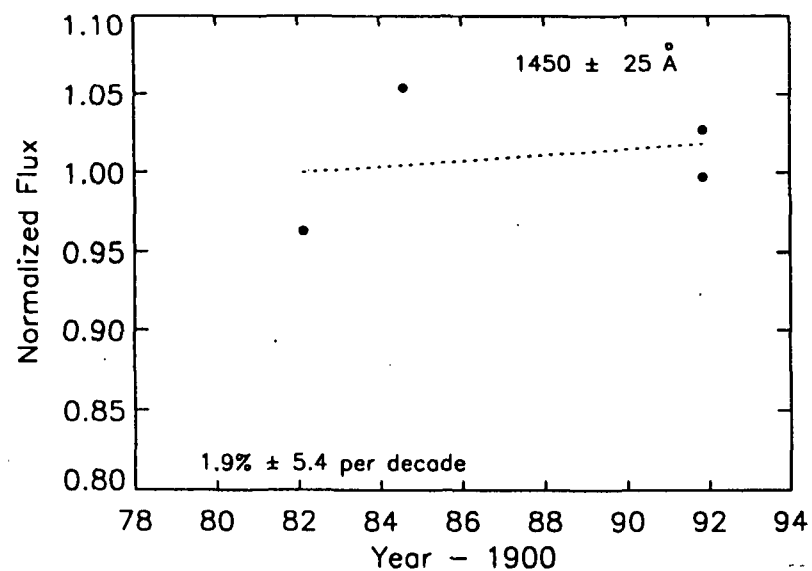
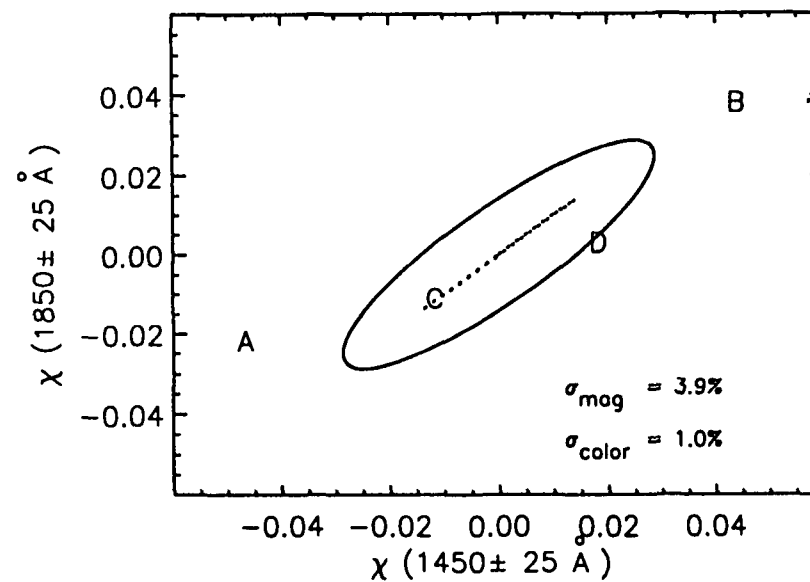
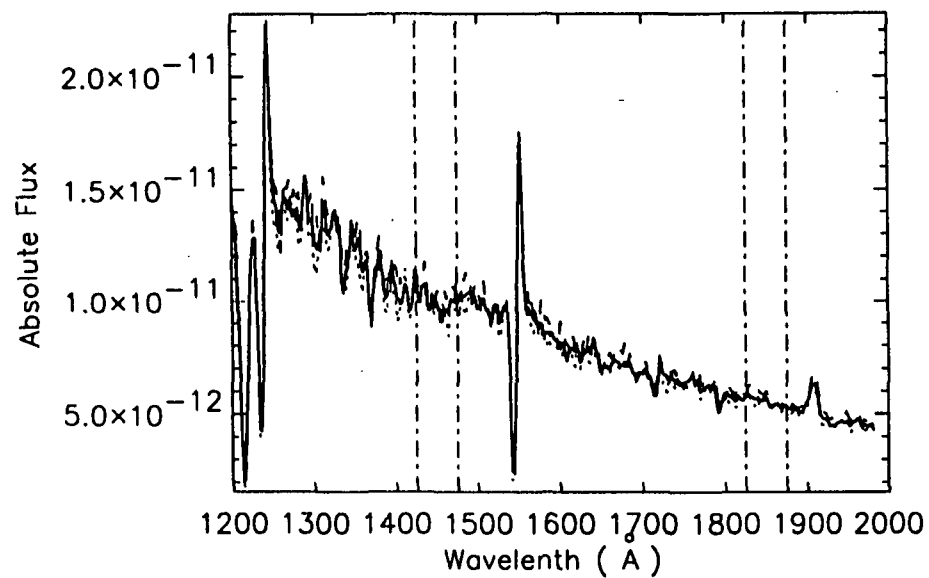
NGC 2392



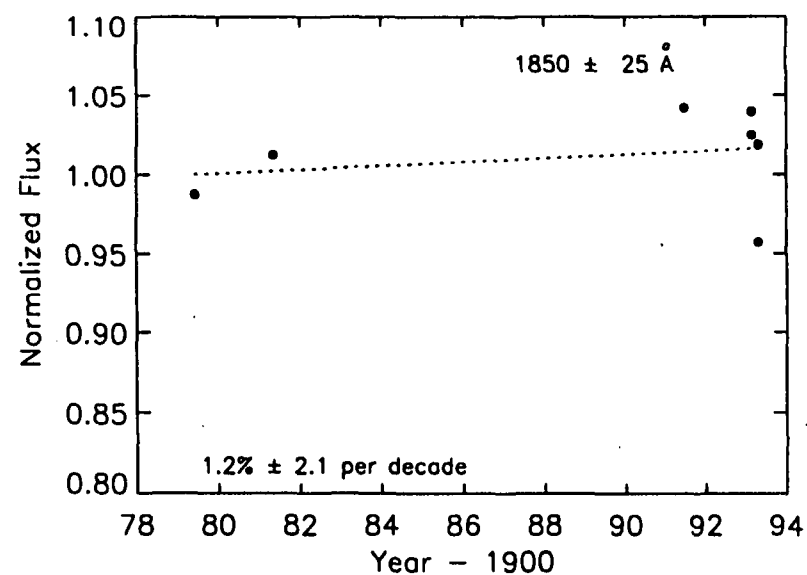
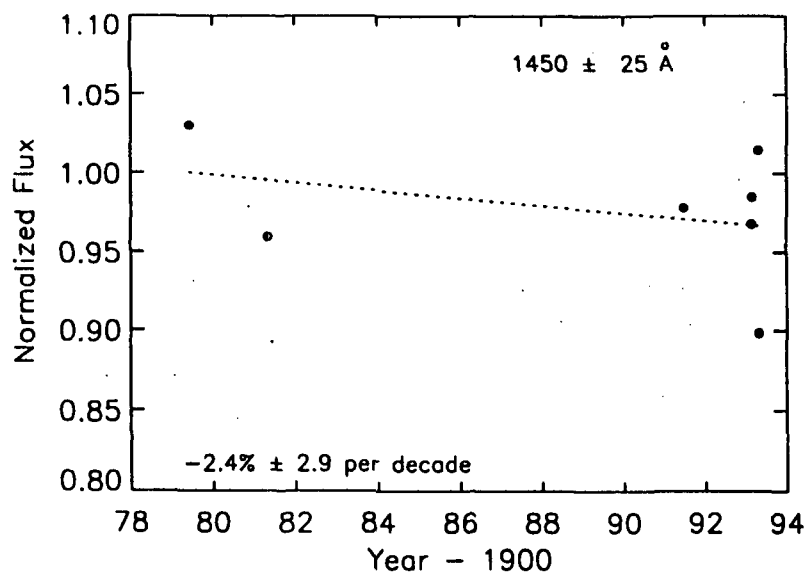
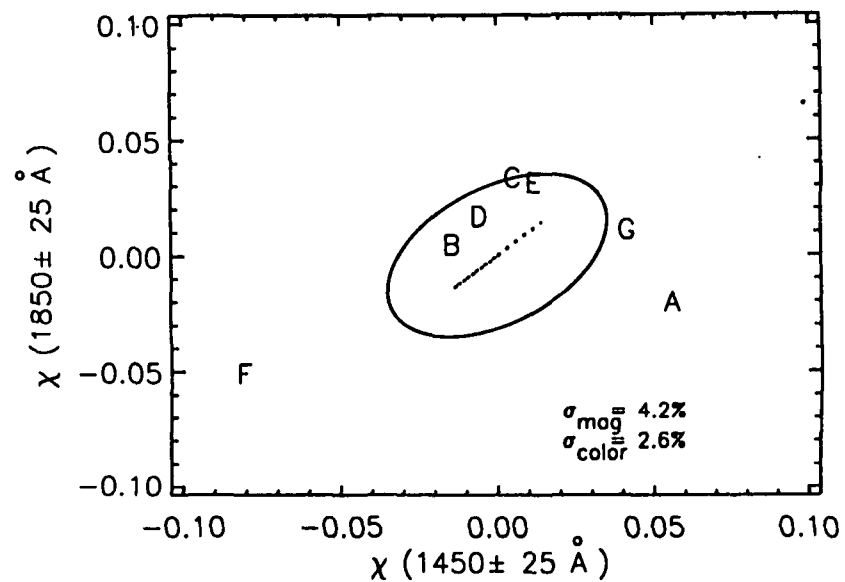
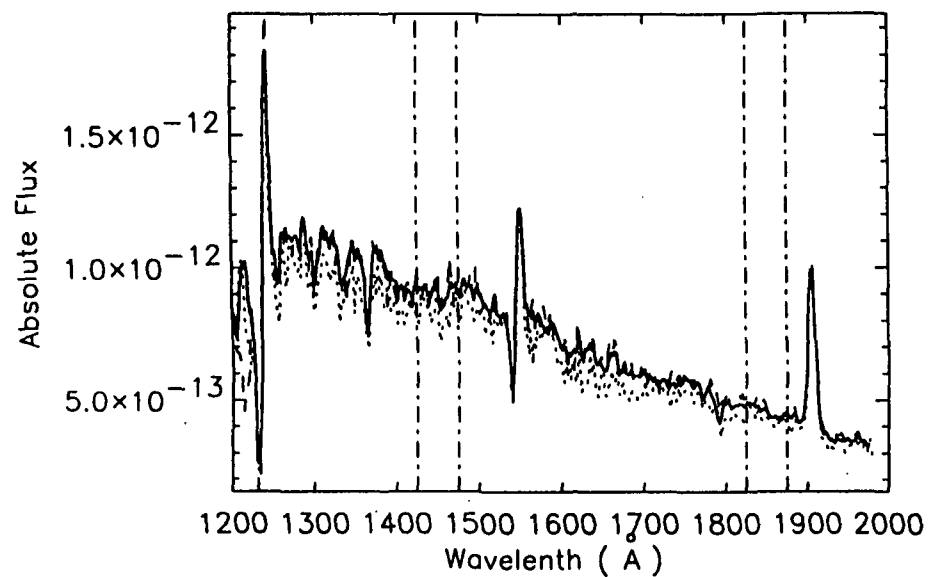
NGC 6891



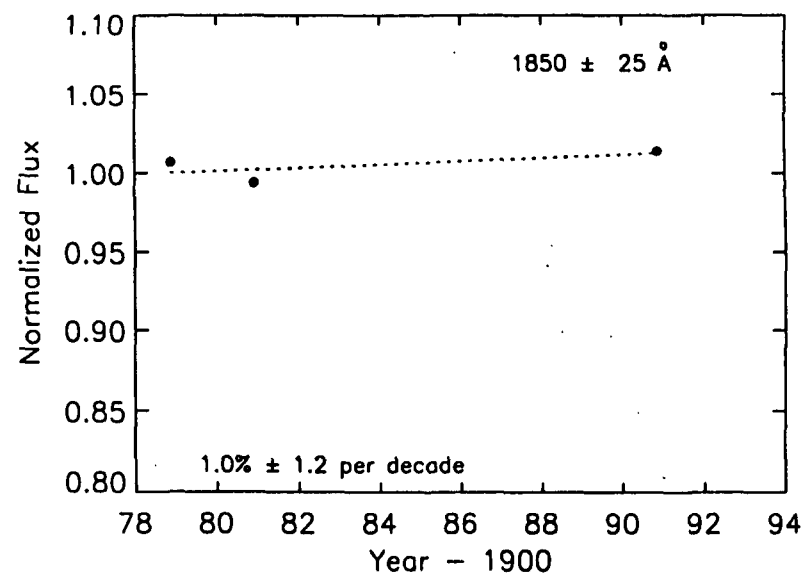
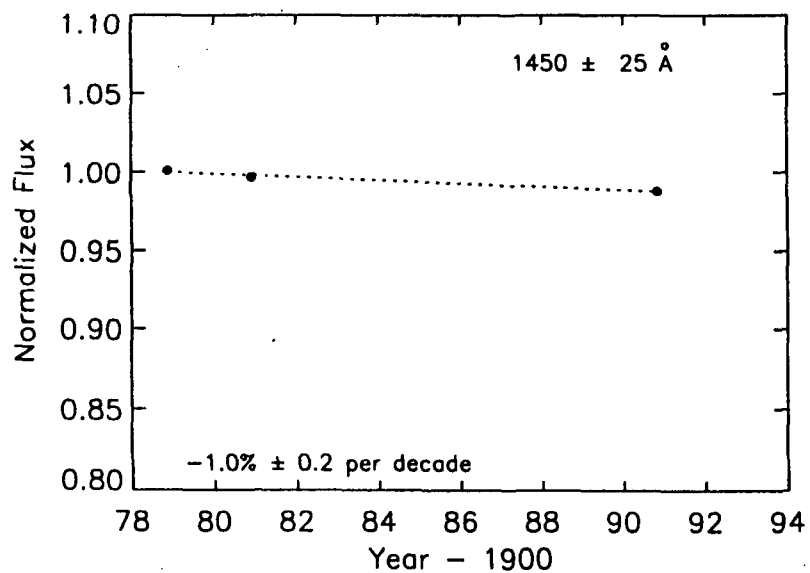
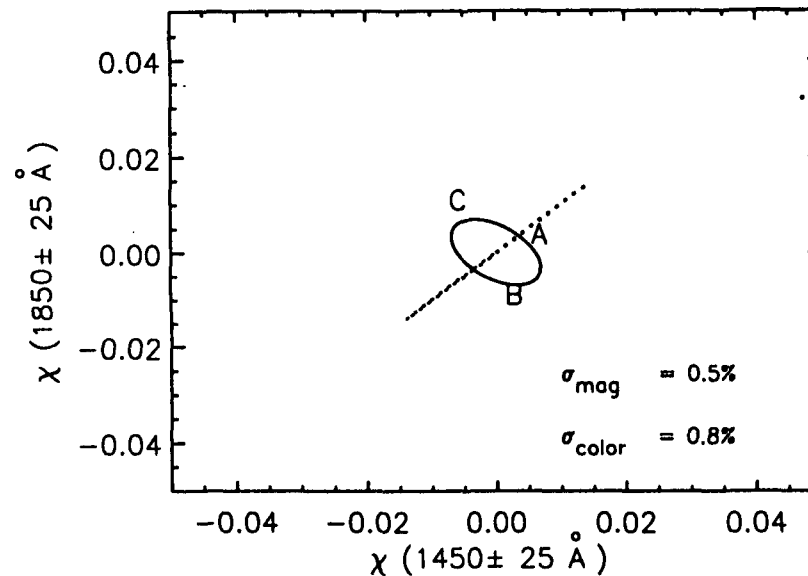
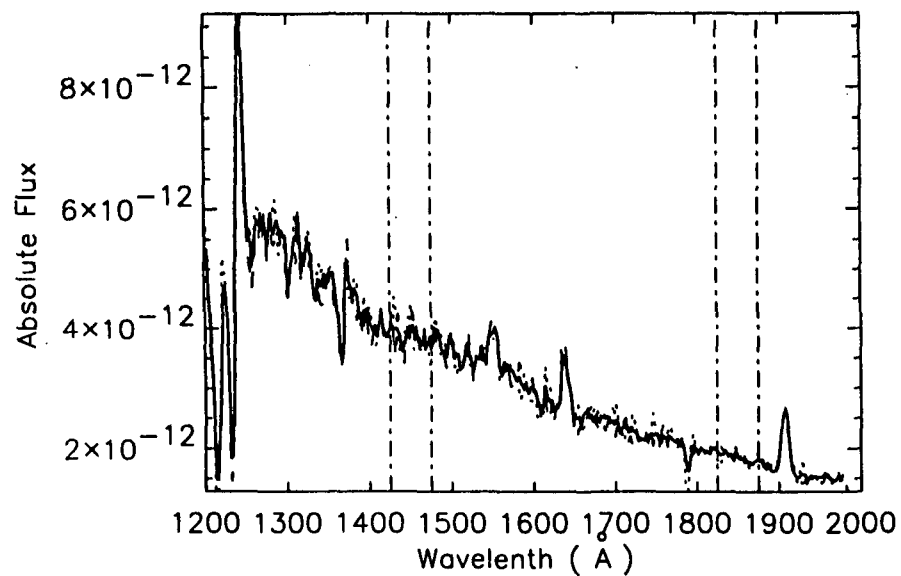
NGC 6826



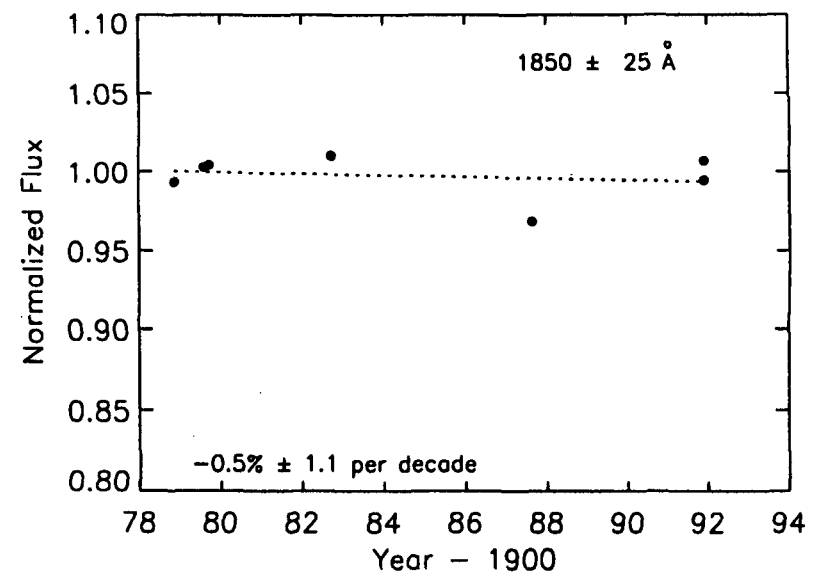
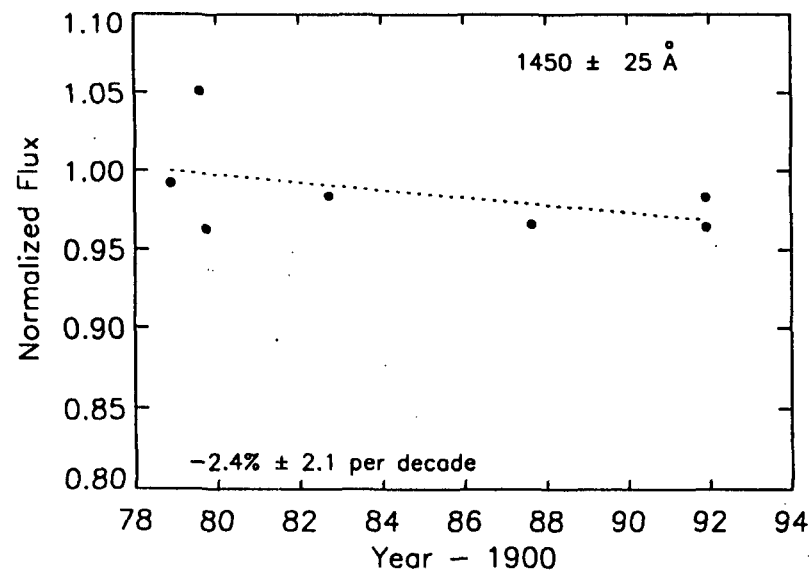
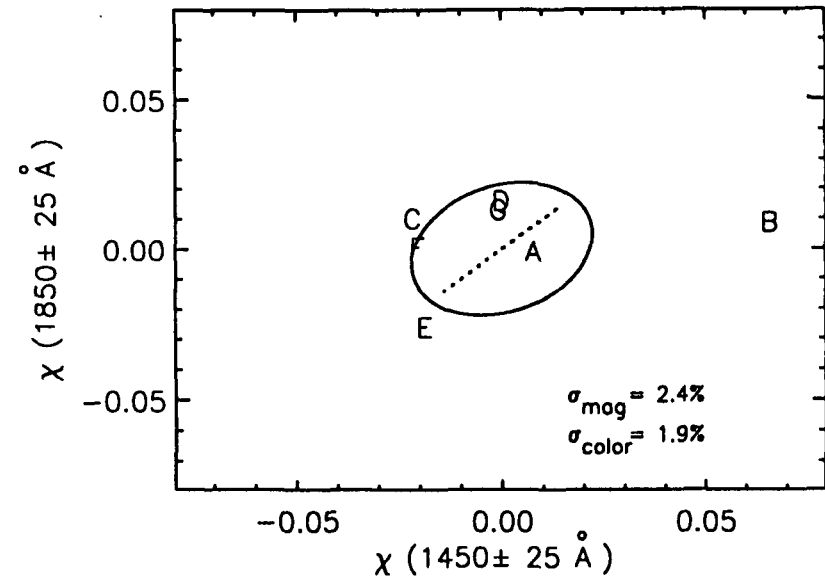
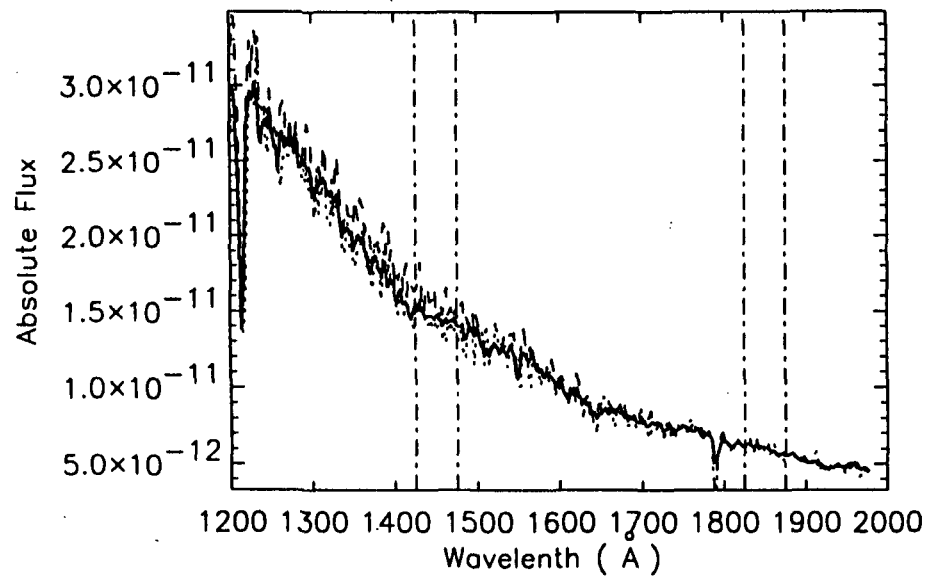
IC 3568



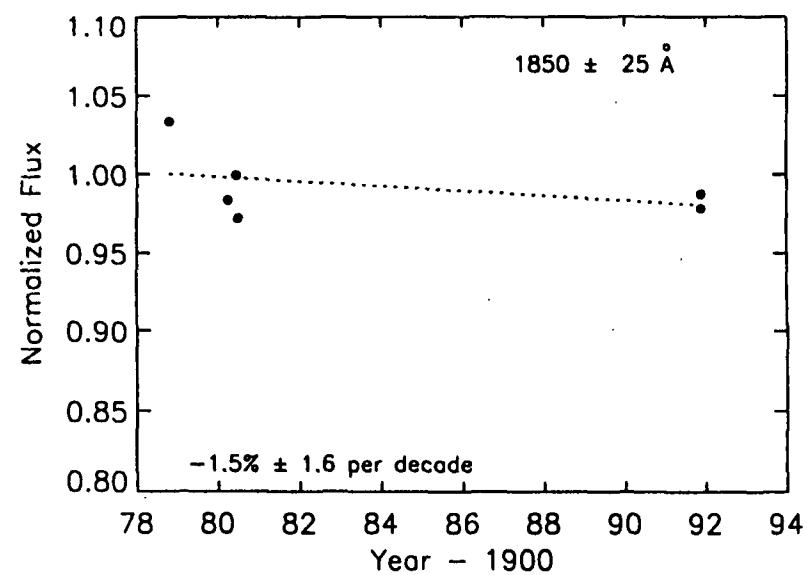
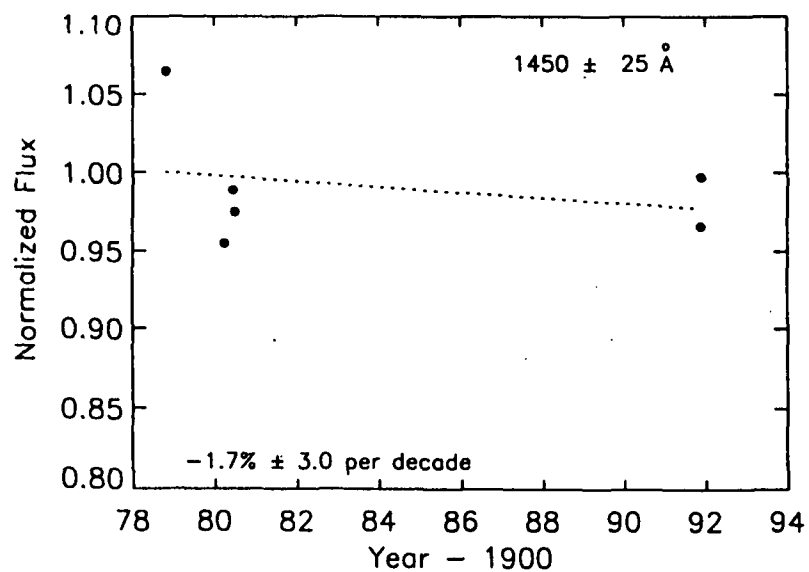
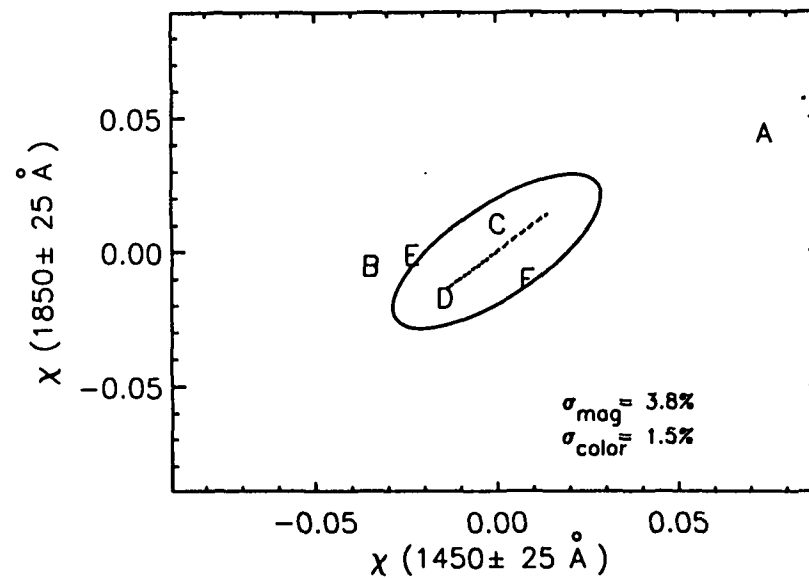
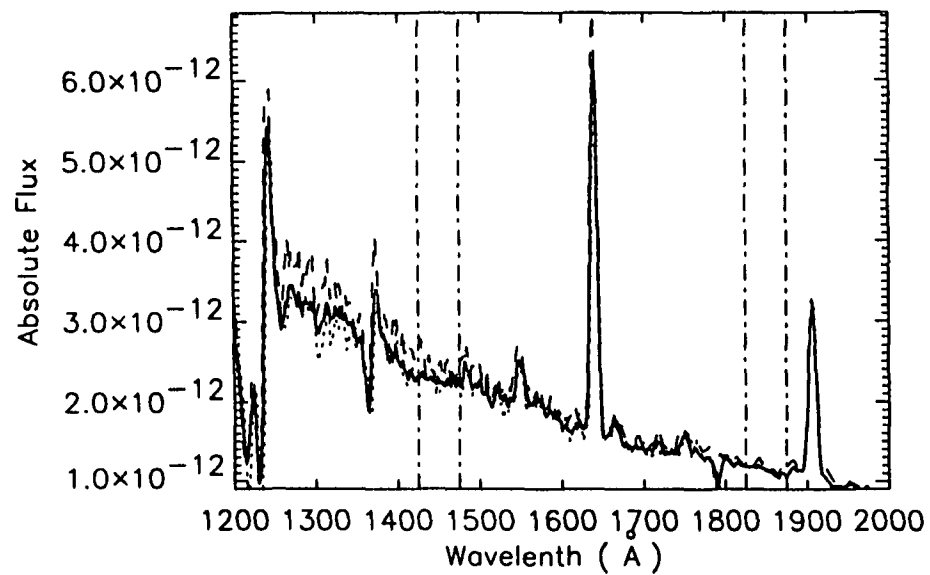
NGC 1535



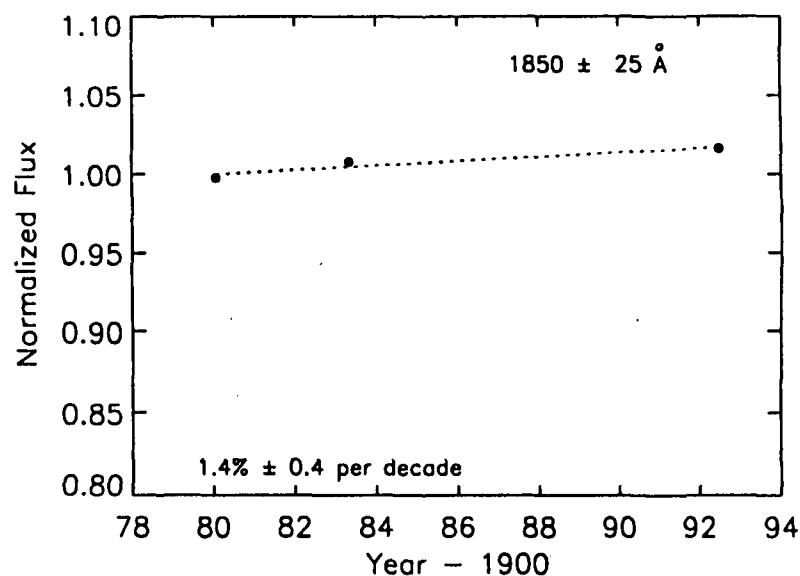
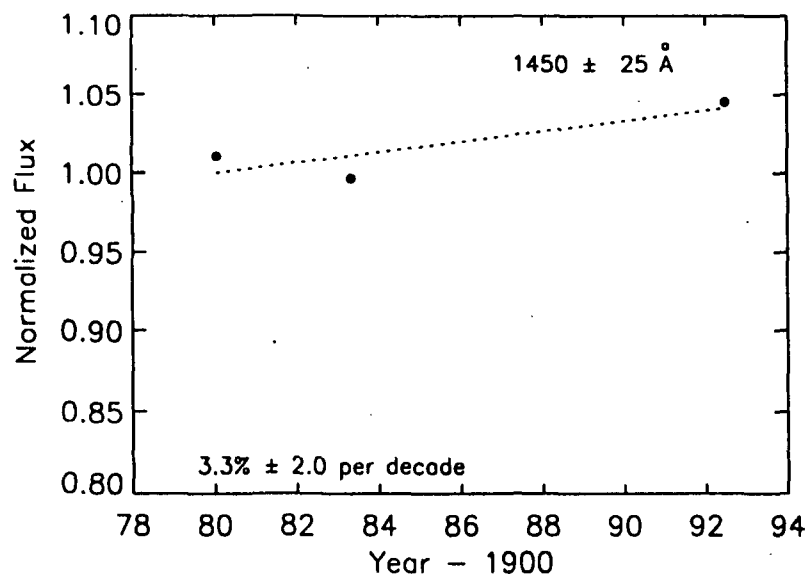
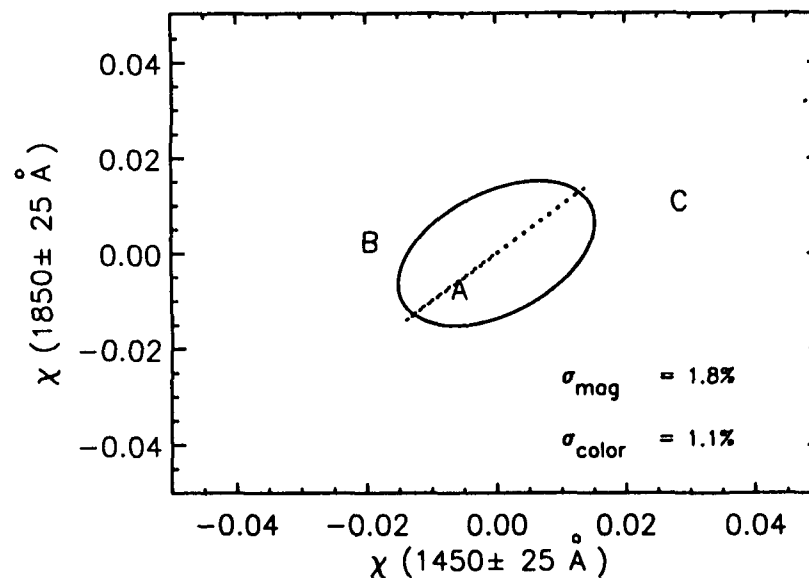
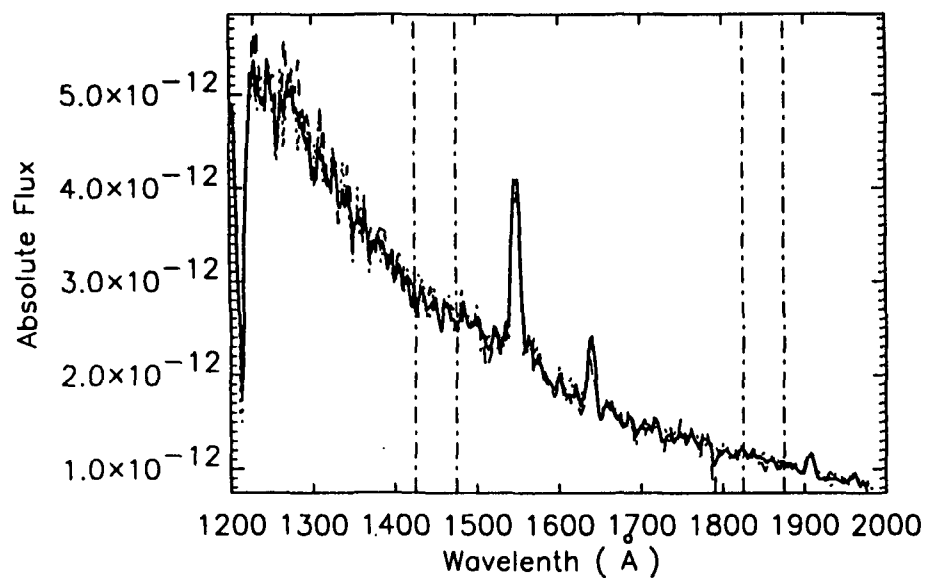
NGC 1360



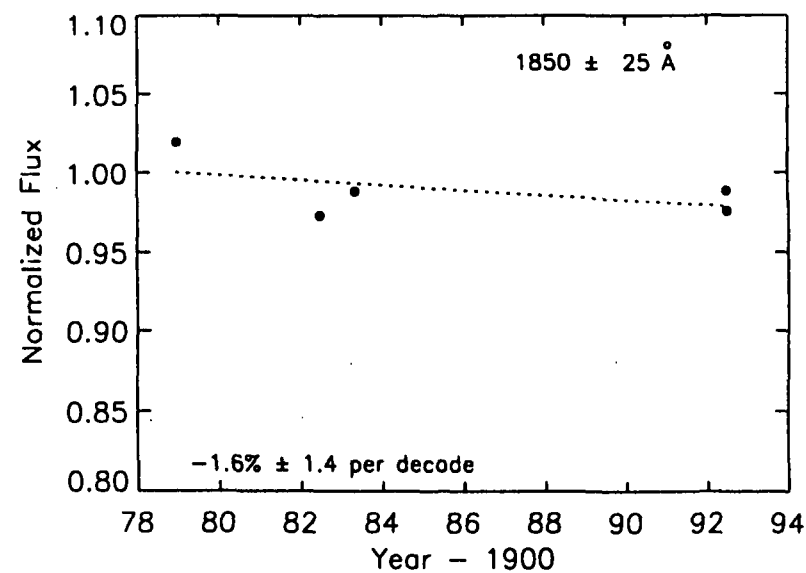
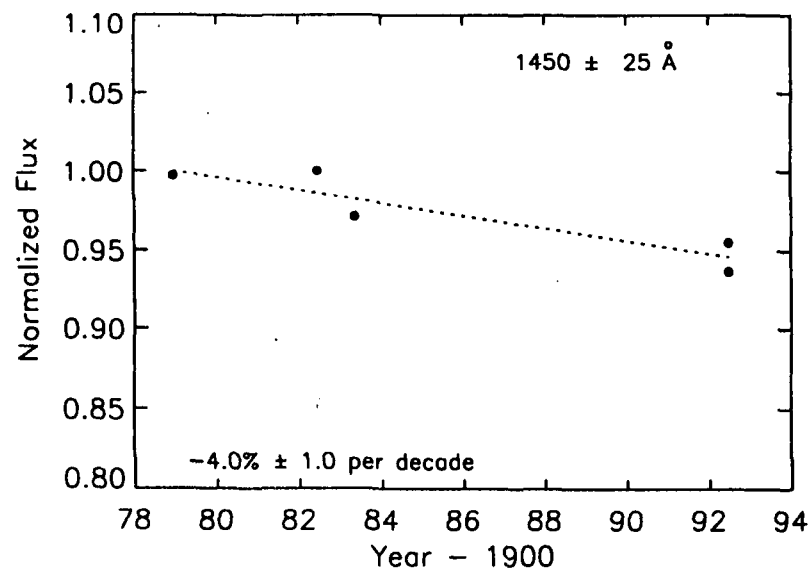
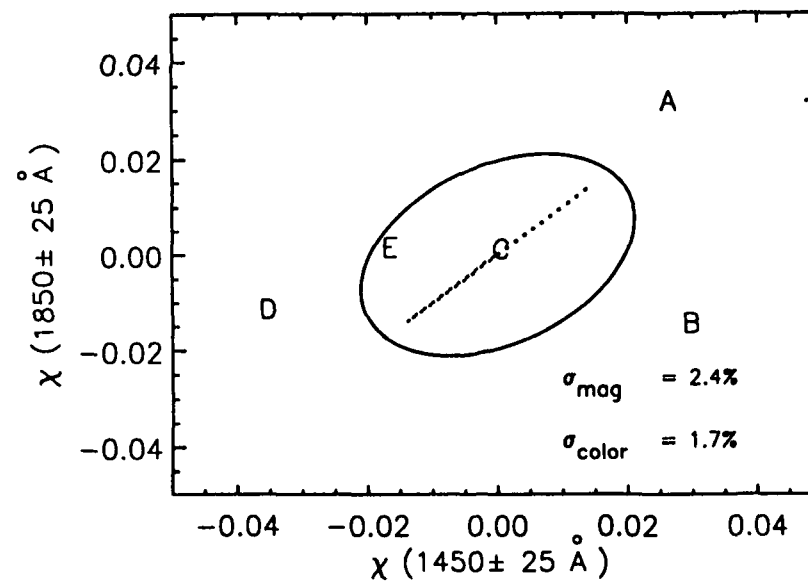
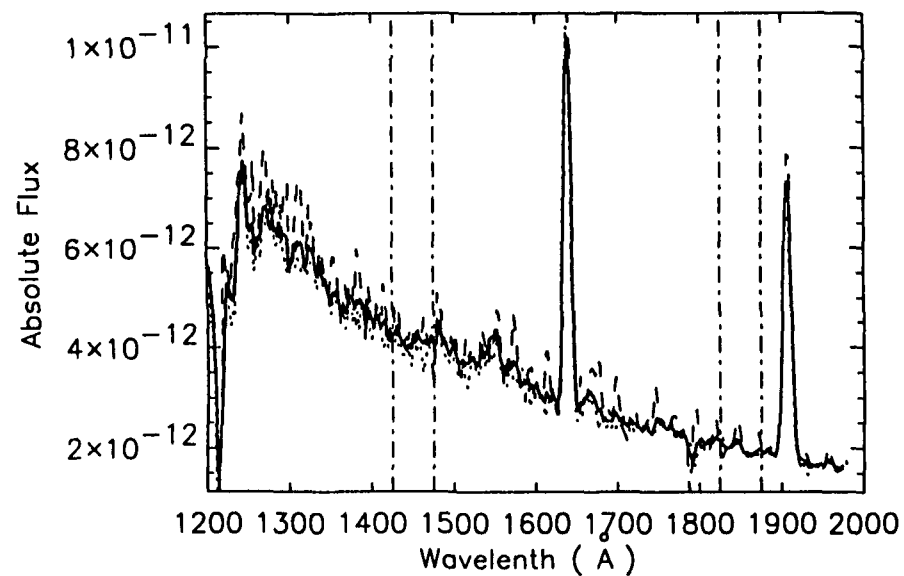
NGC 7009



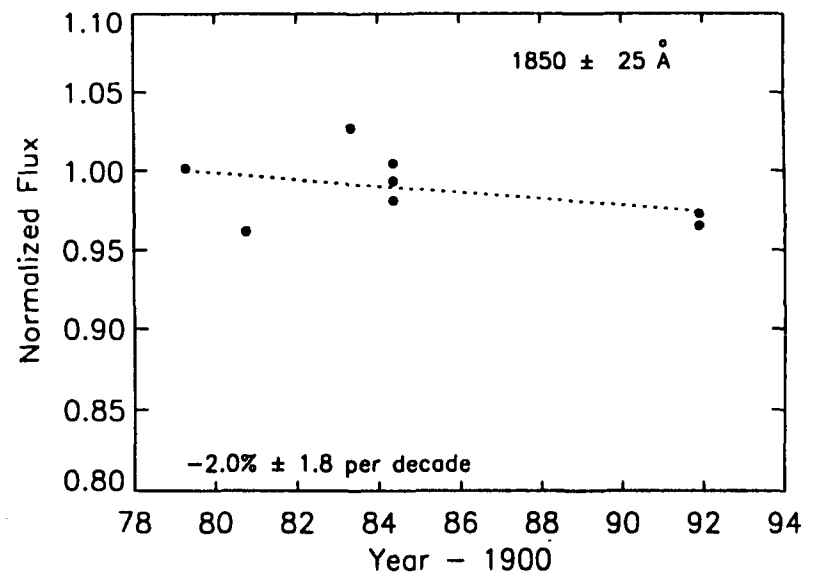
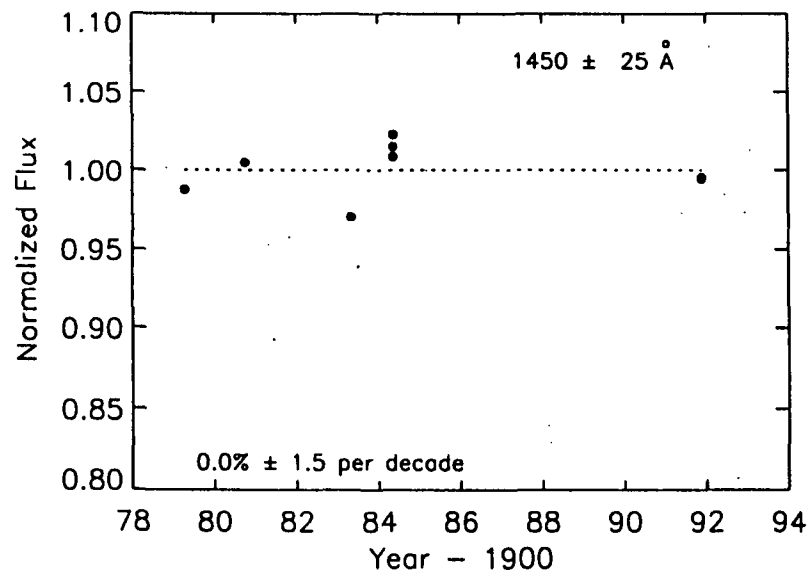
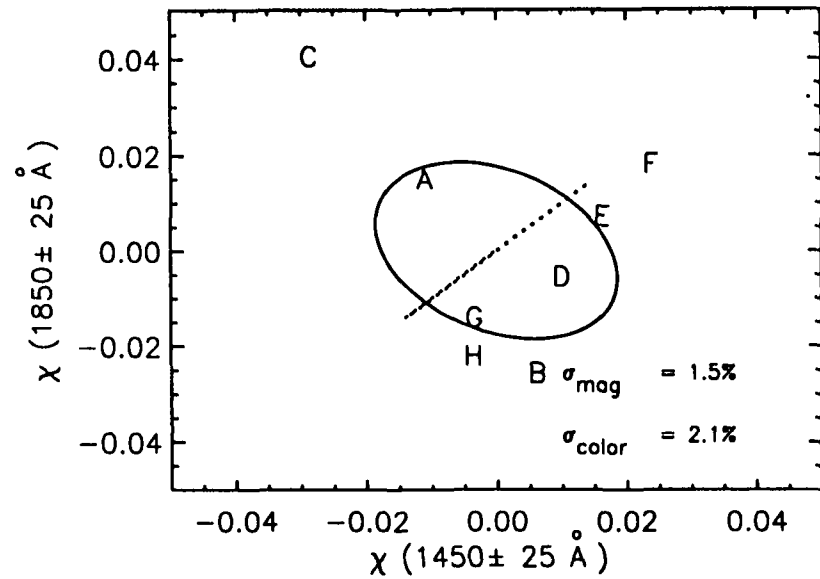
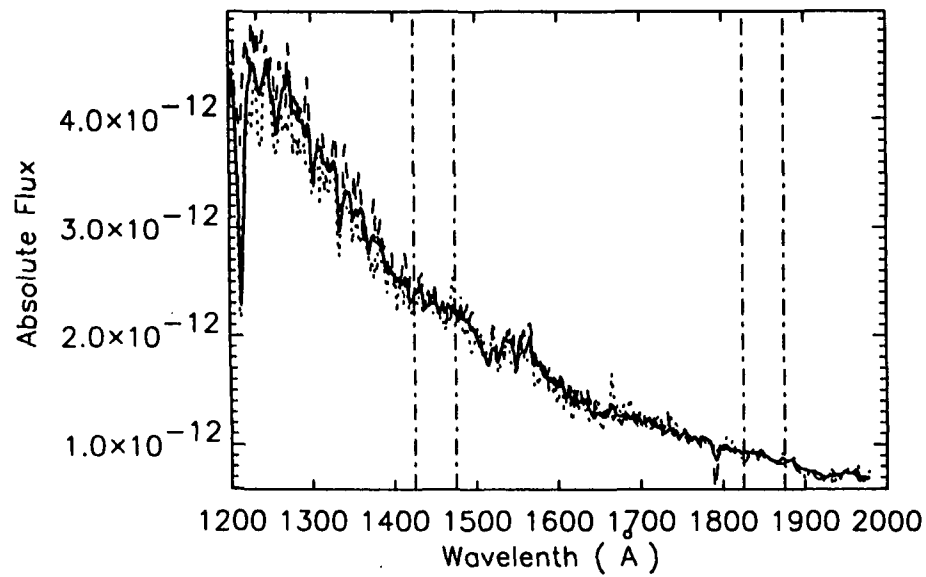
NGC 4361



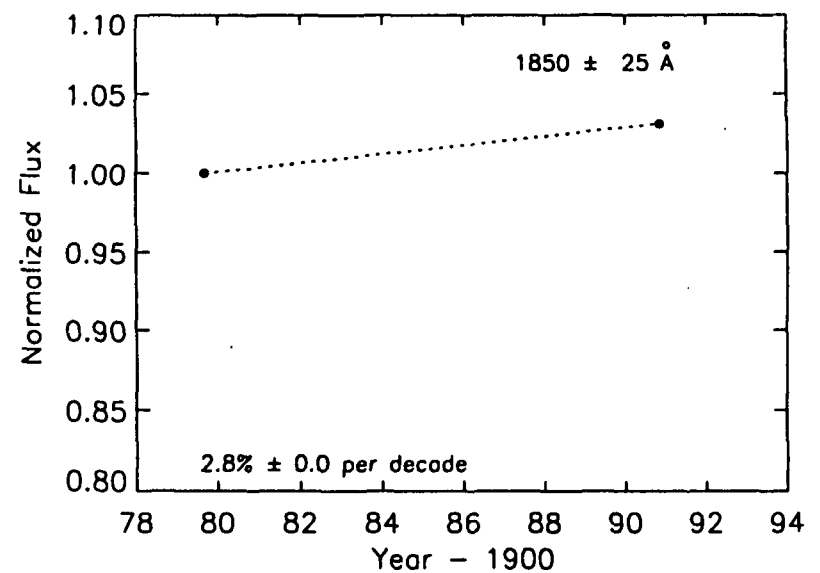
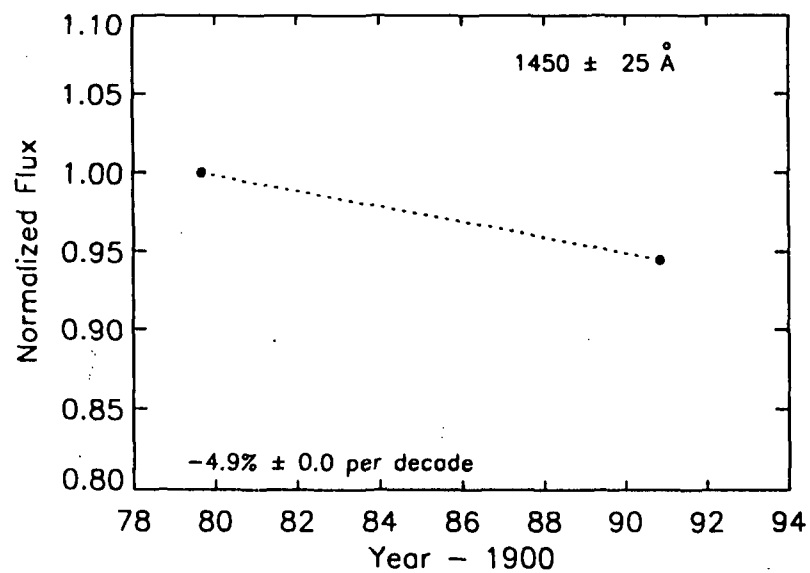
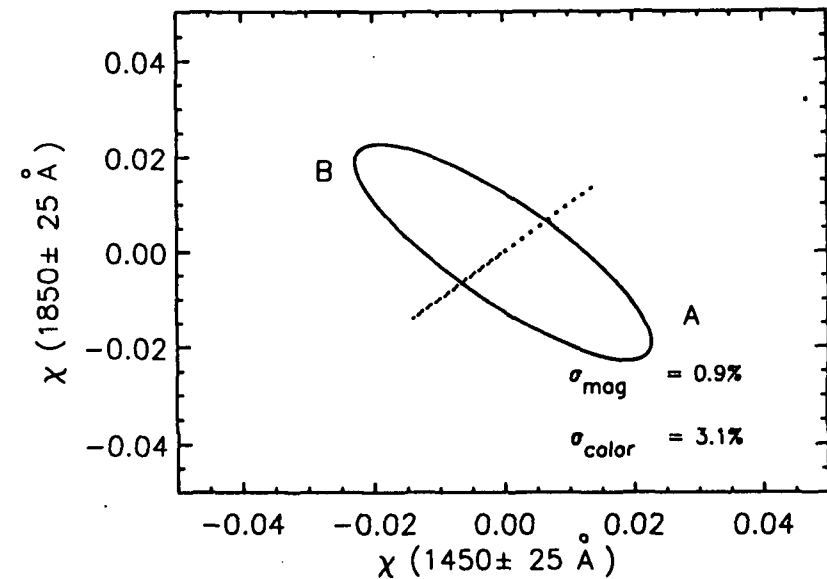
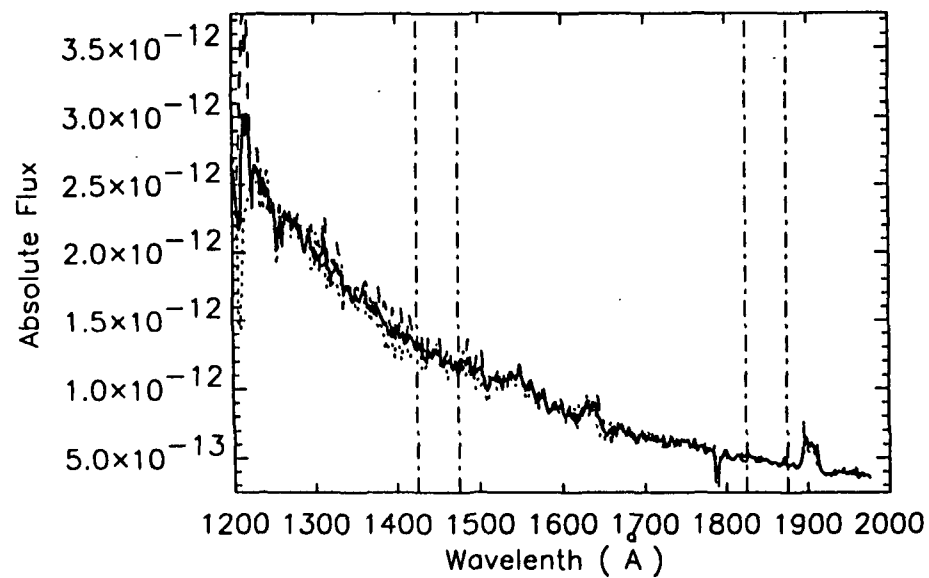
NGC 3242



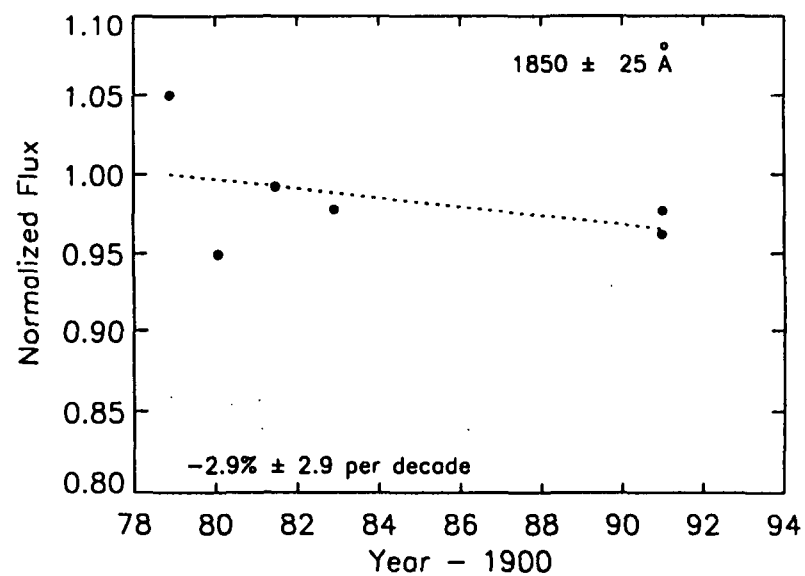
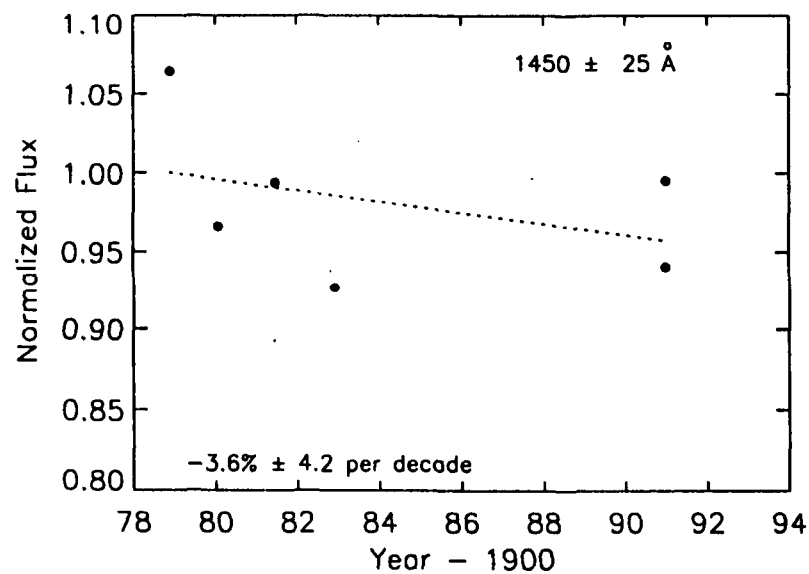
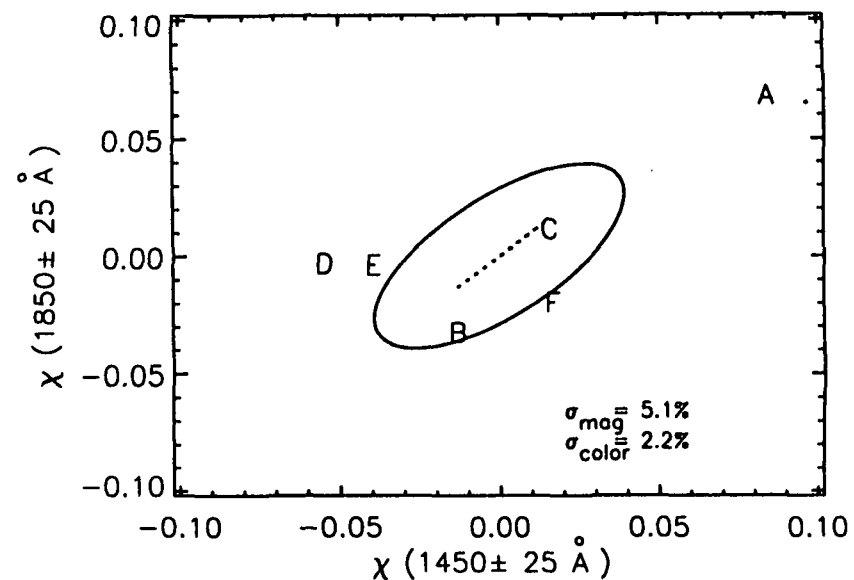
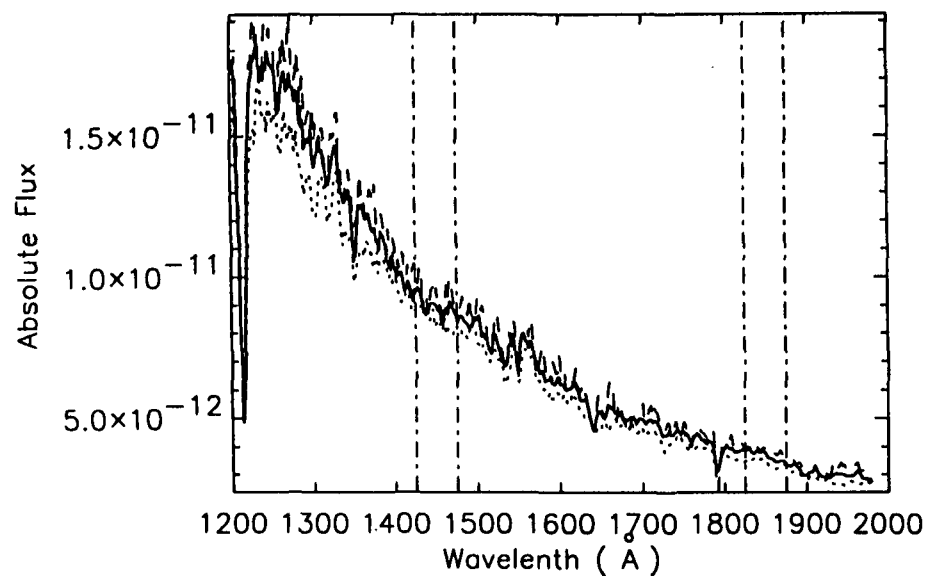
NGC 7293

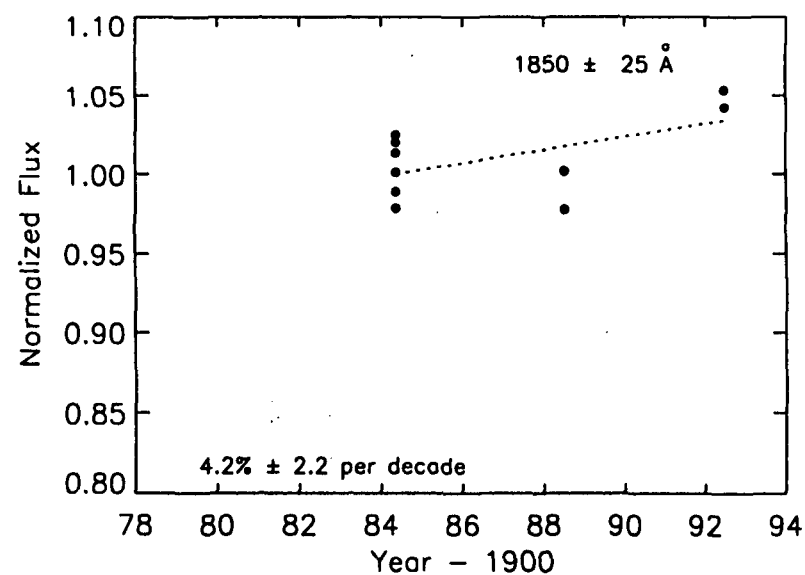
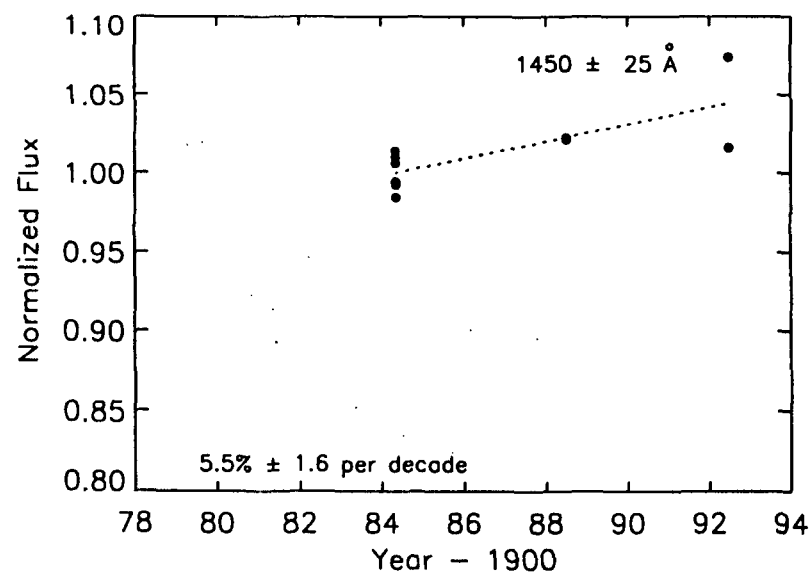
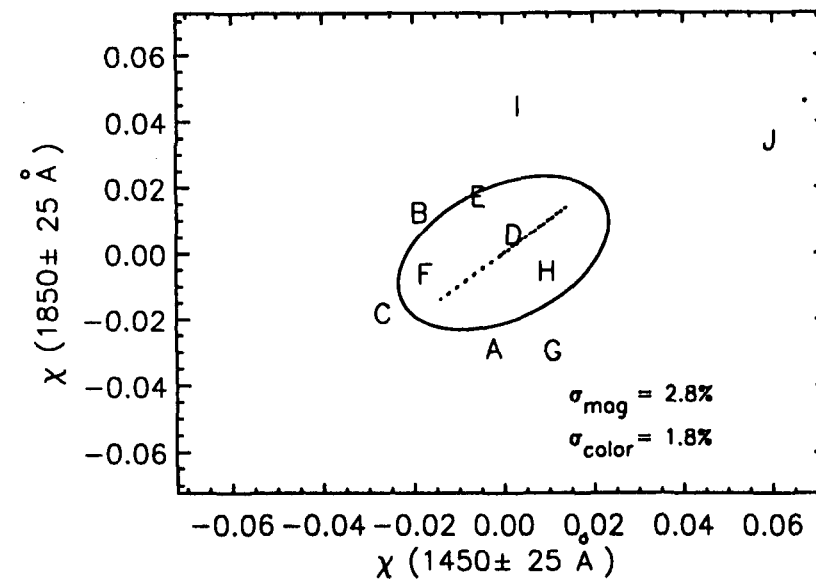
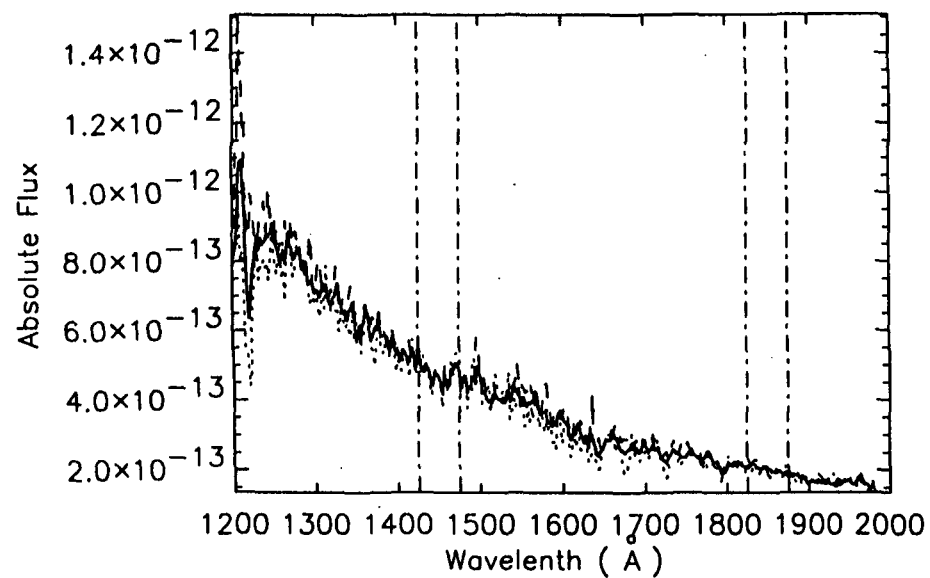


NGC 6853

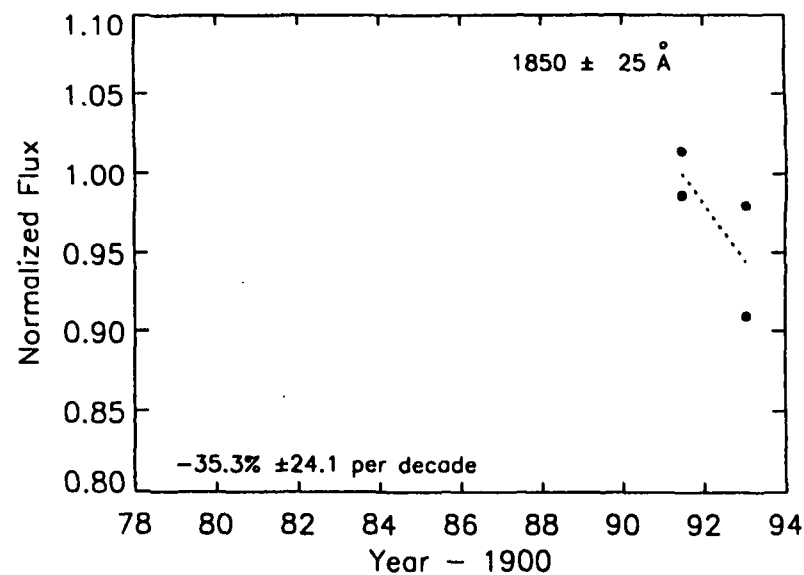
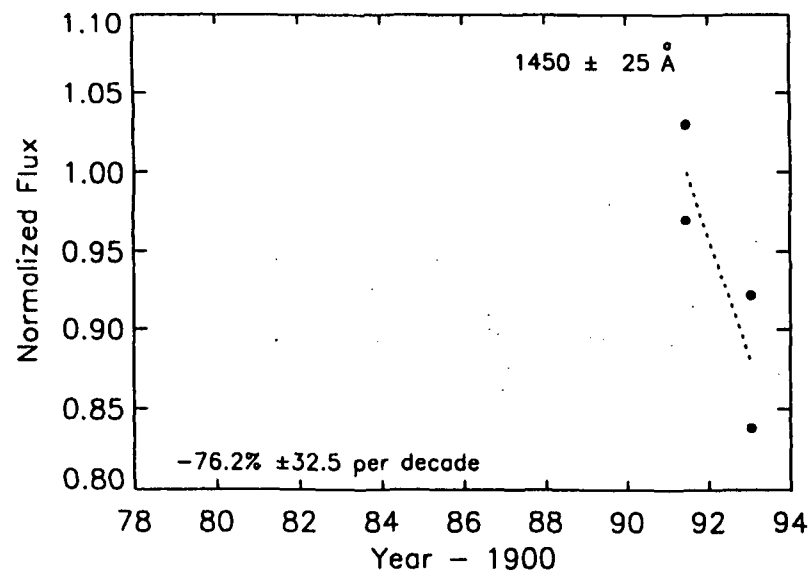
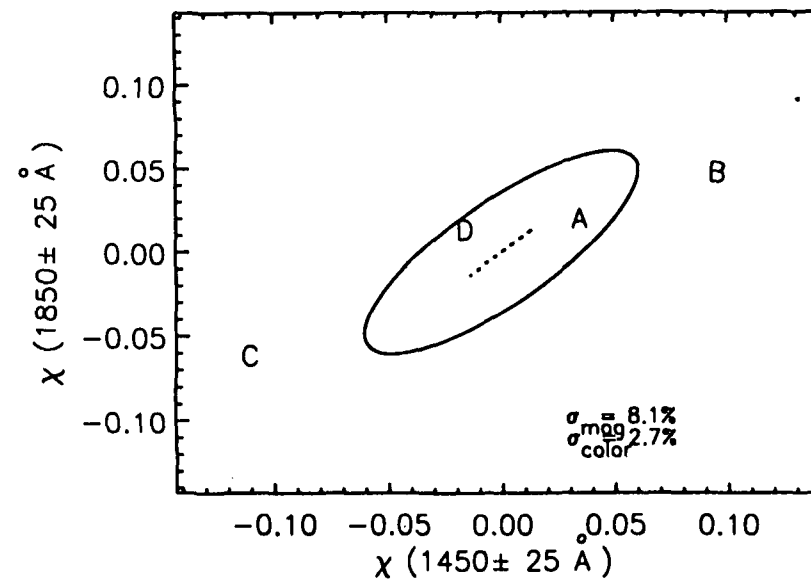
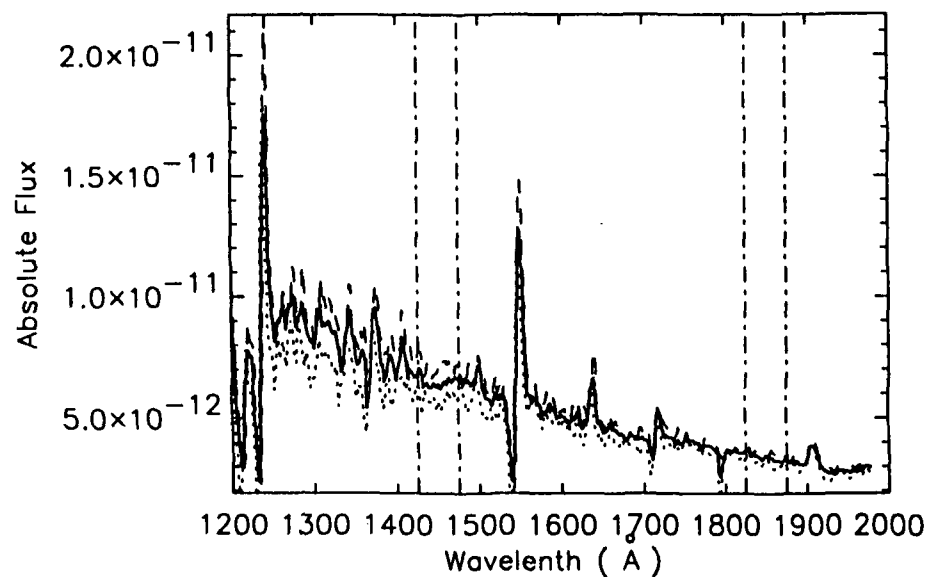


NGC 246

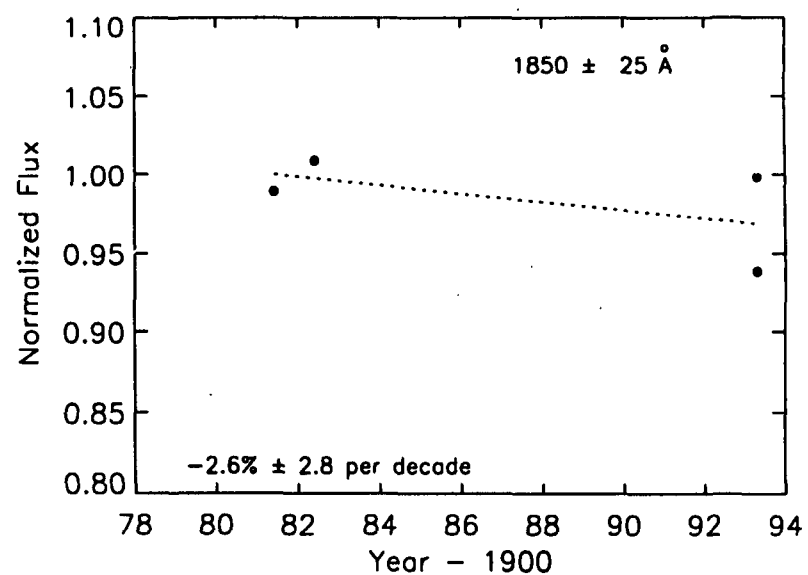
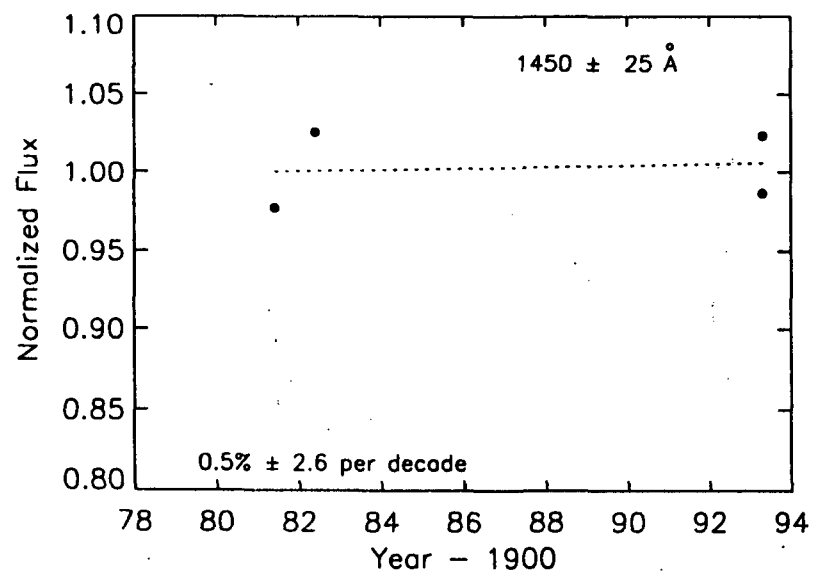
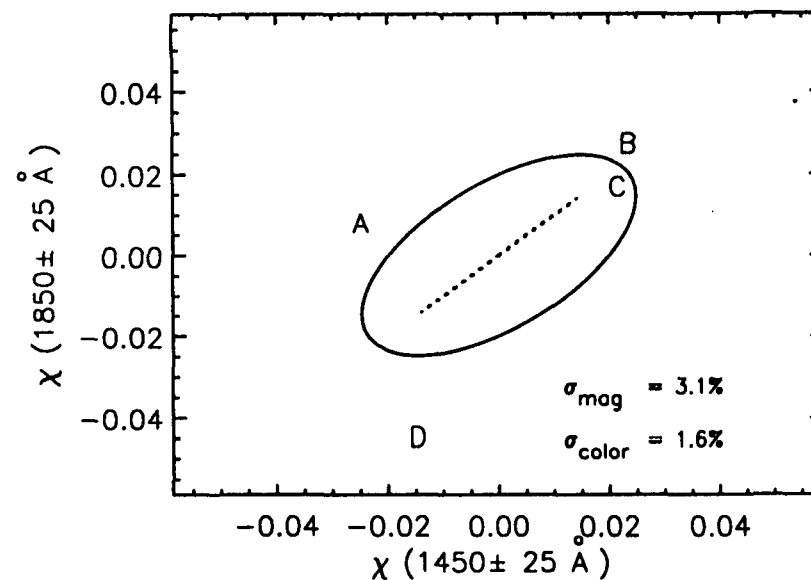
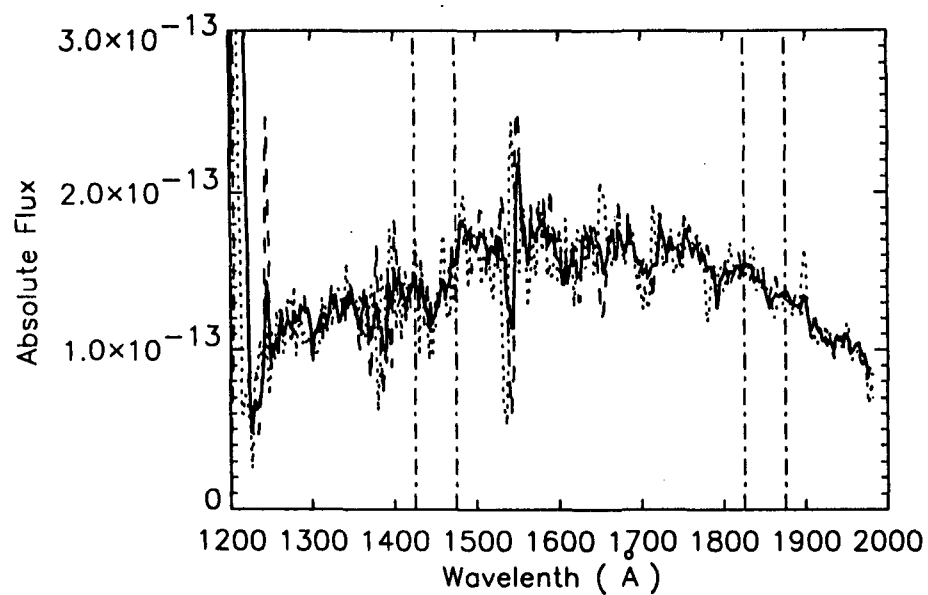




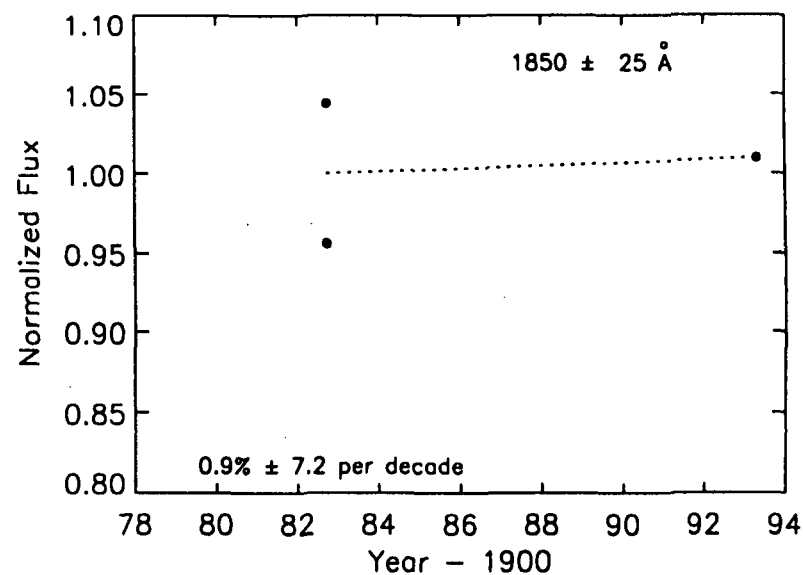
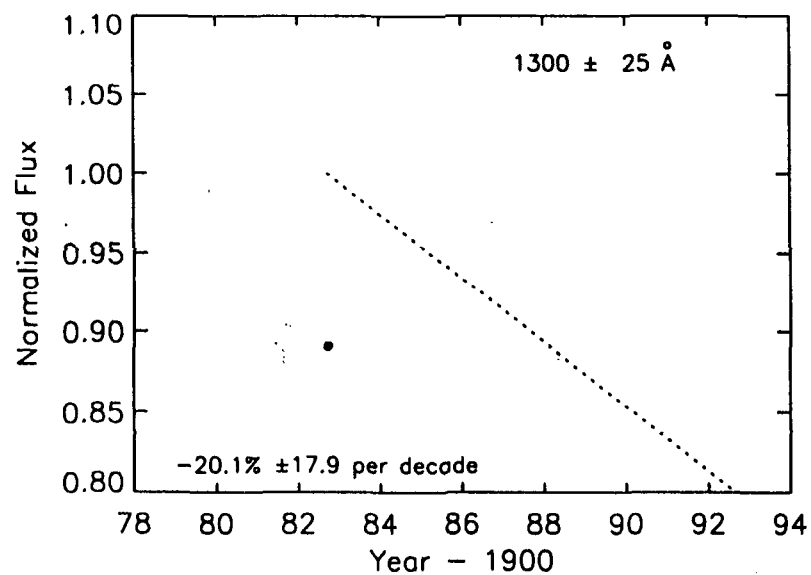
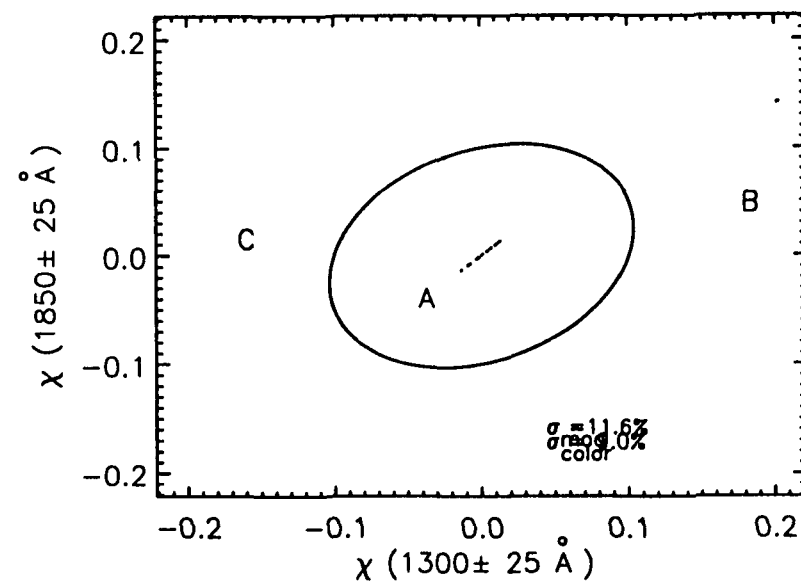
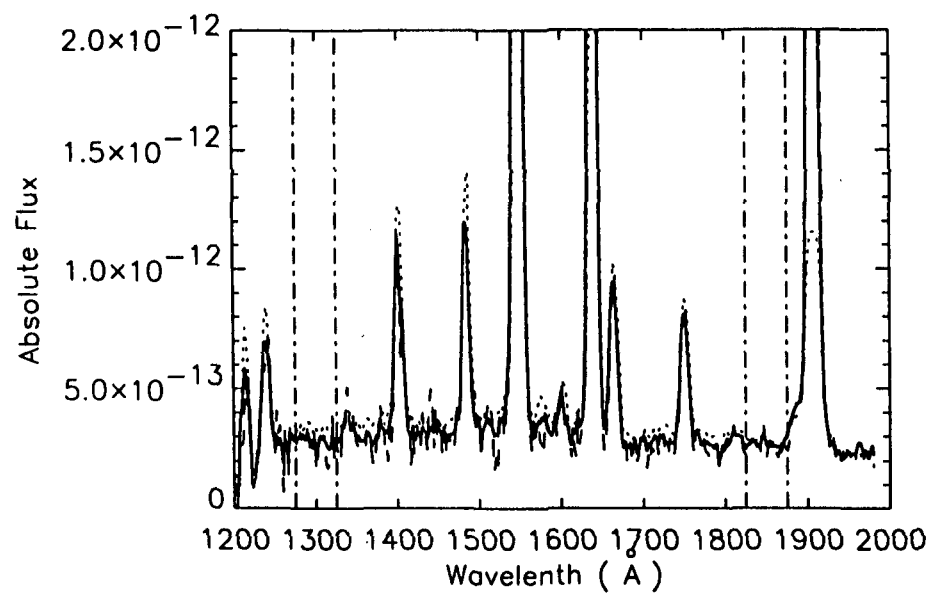
NGC 6543



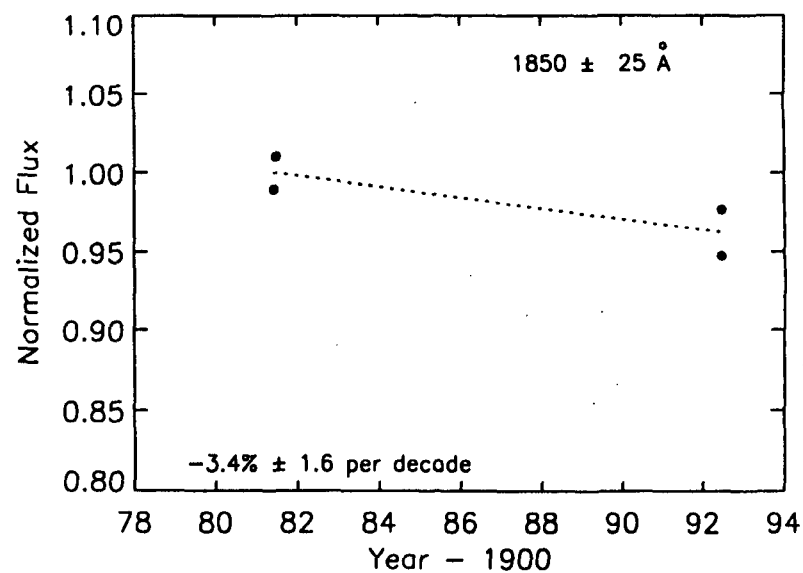
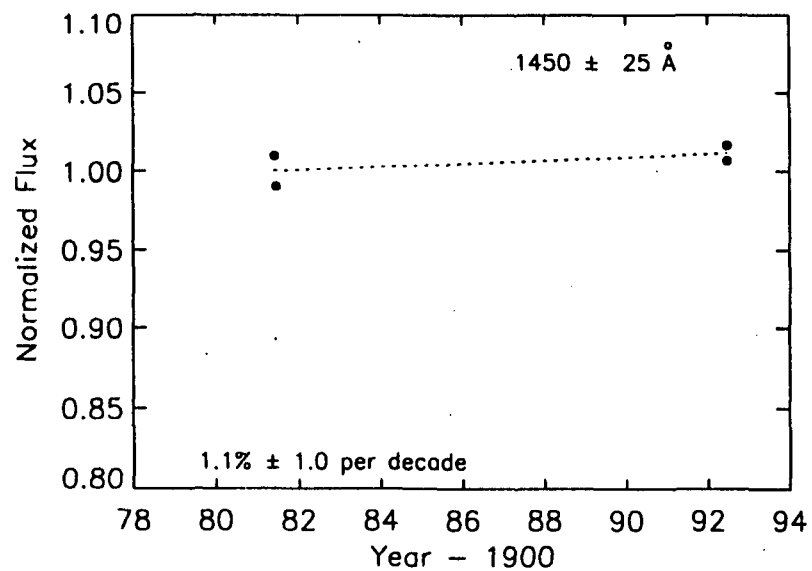
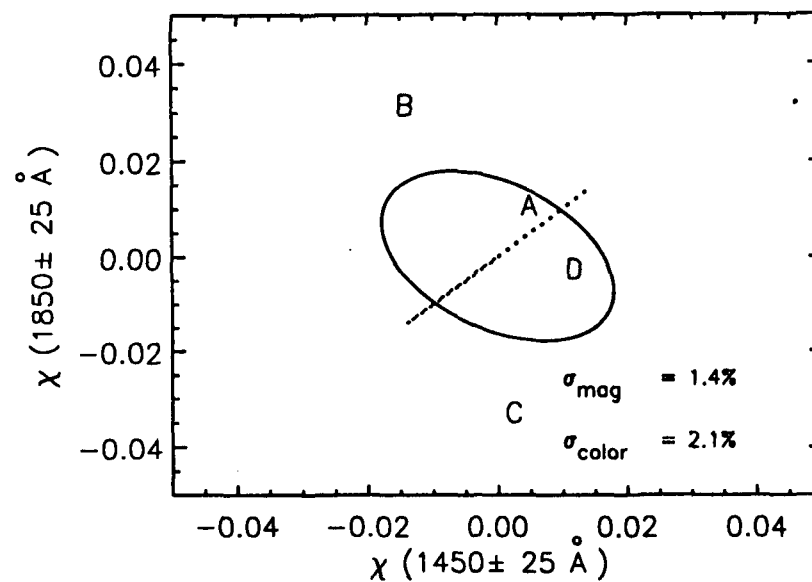
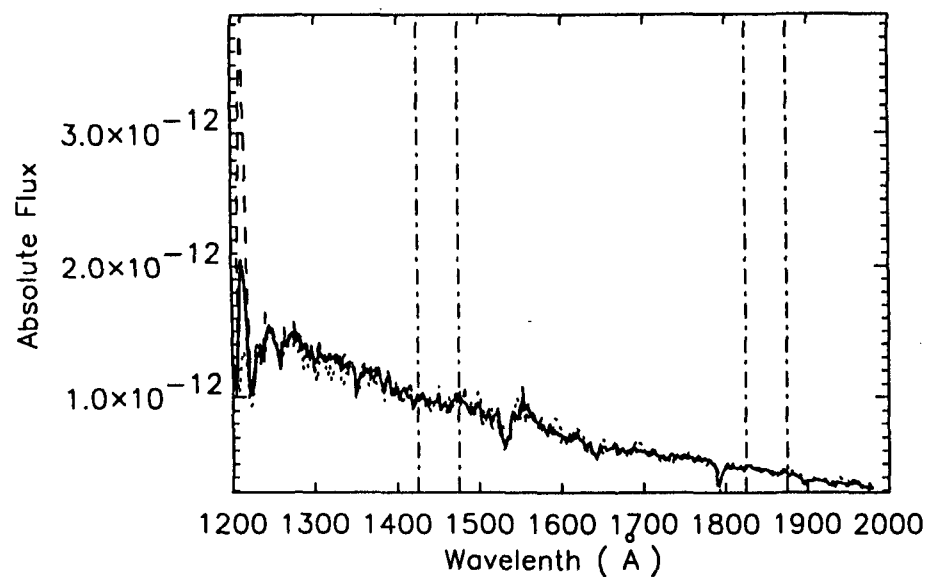
He 2-108



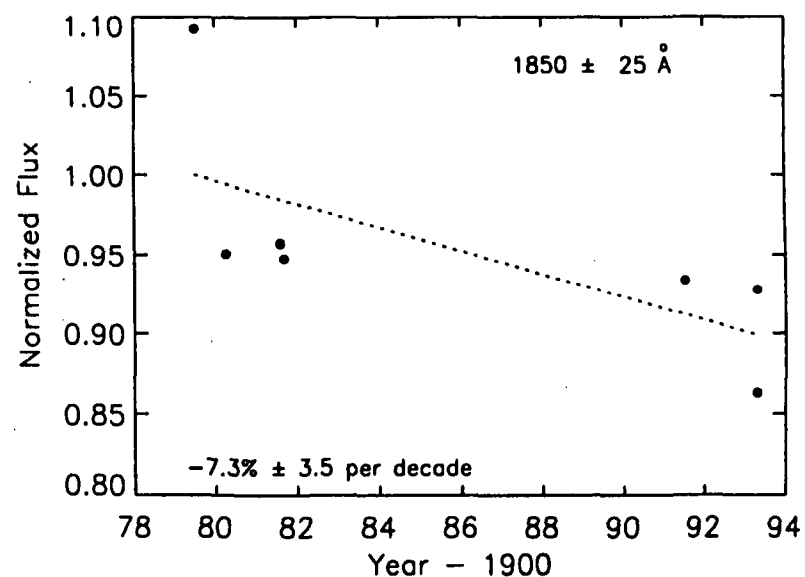
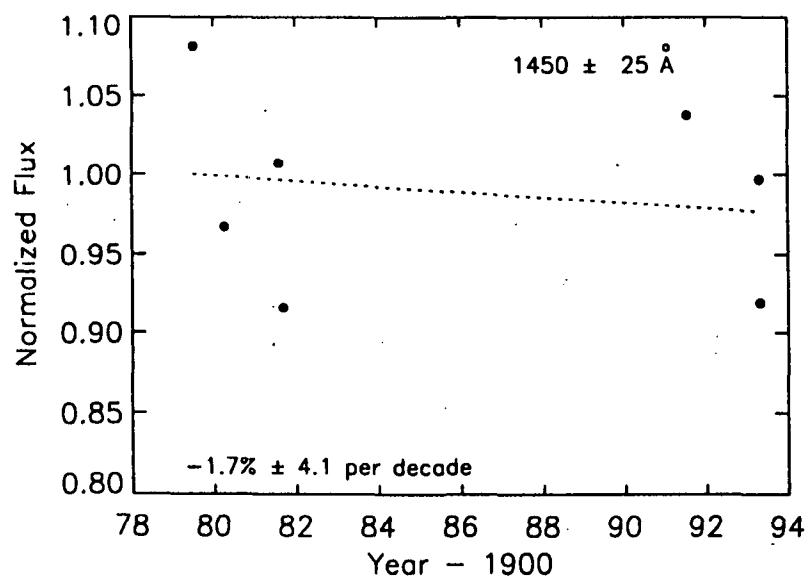
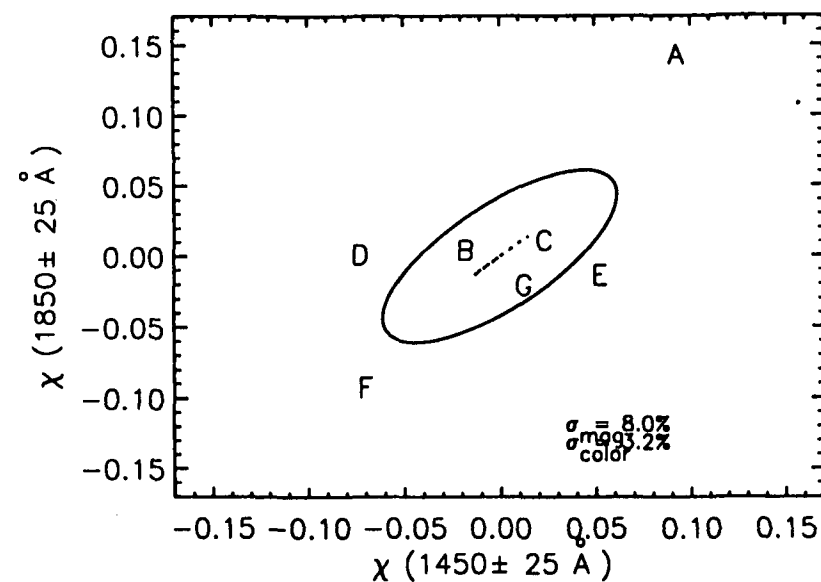
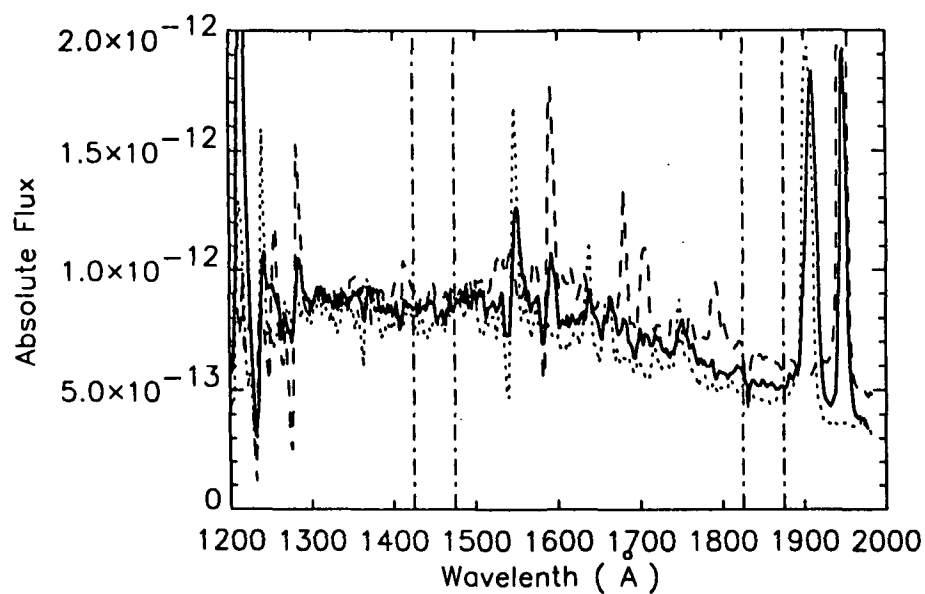
NGC 3918



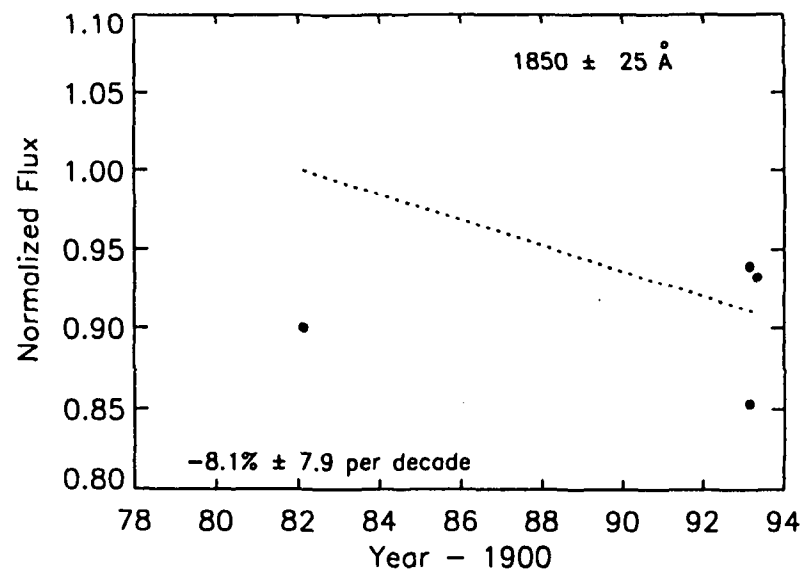
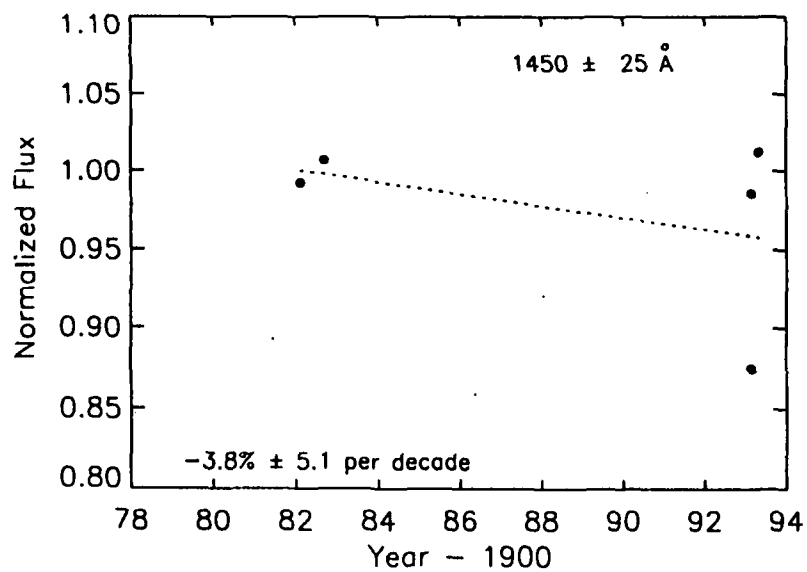
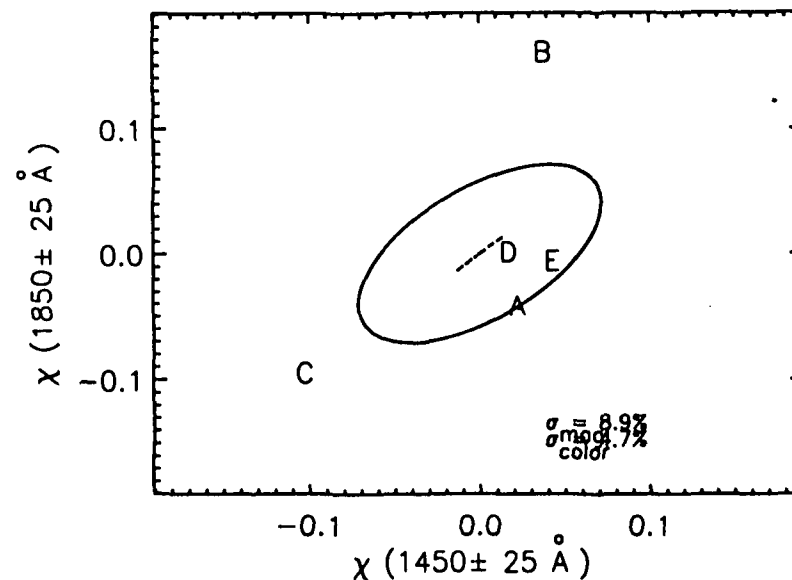
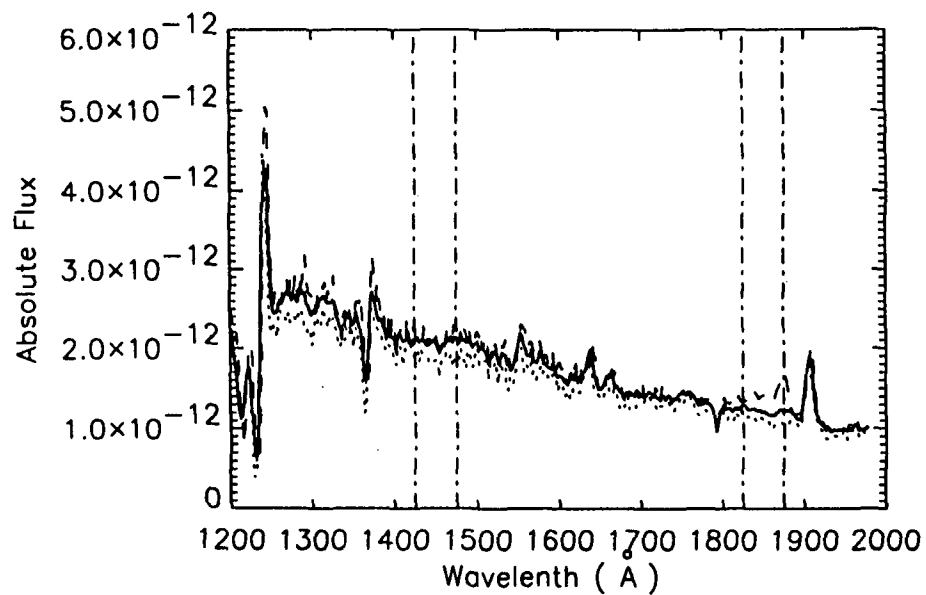
NGC 7094



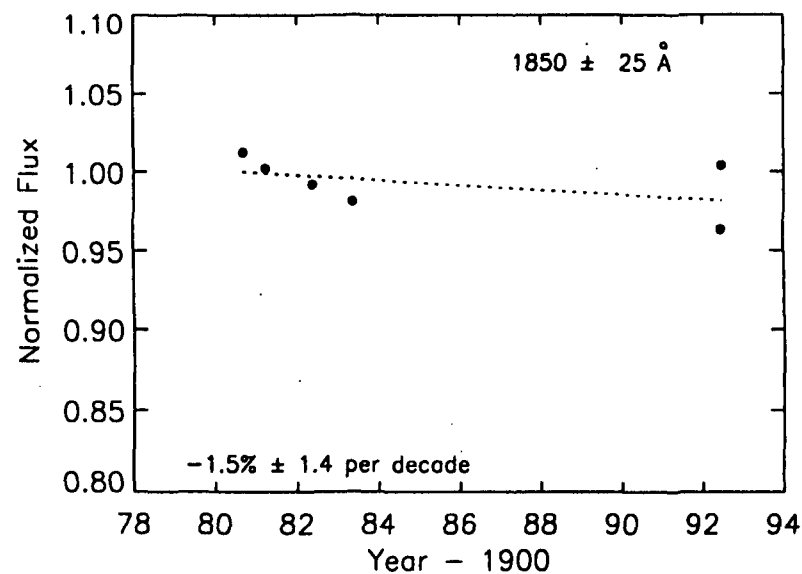
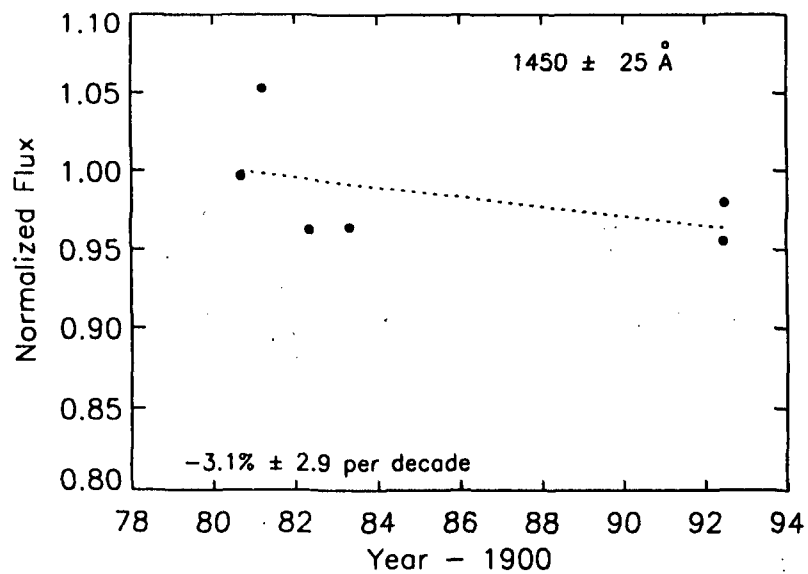
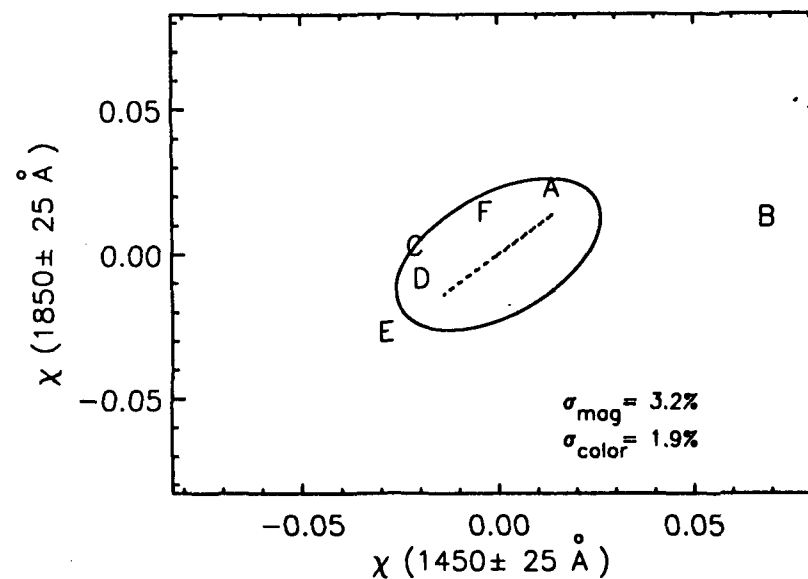
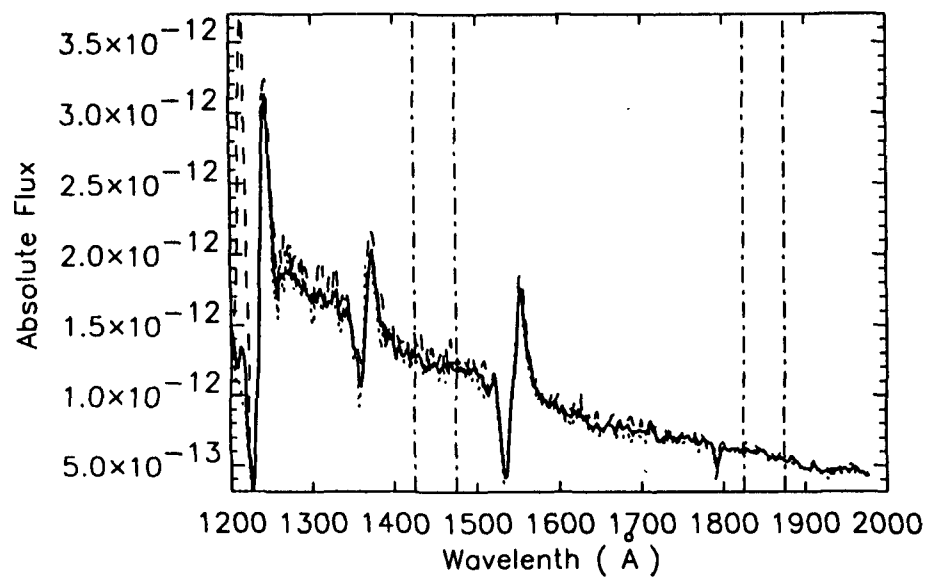
NGC 6572



NGC 6210



Abell 78



Sensitivity of BB Flux in SWP Bandpass to Temperature

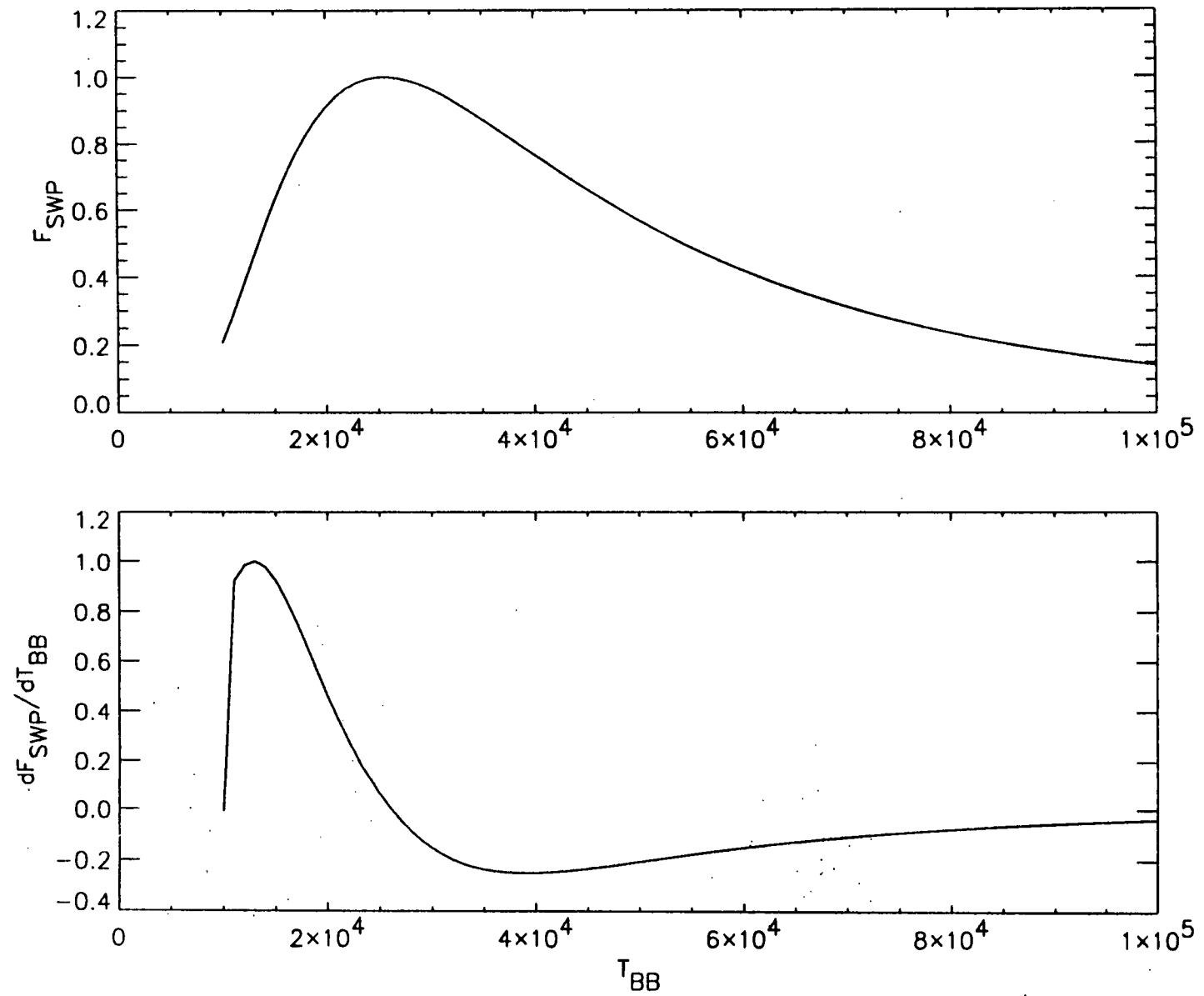


Figure 5

Table 1: CSPN in Fading Study

OBJECT	IMAGE	YEAR	DAY	T (SEC)	COMMENTS
BD +30 3639	4923	1979	102	330	
(WC9)	8590	1980	89	300	
	41867	1991	169	300	
	41868	1991	169	300	Errors at reference point
He 2-131	6772	1979	279	360	
(O7f-eq)	41912	1991	312	360	
	47003	1993	51	360	
	47004	1993	51	360	
He 2-138	6720	1979	275	240	
	35601	1989	252		
	35602	1989	252	600	
	47005	1993	51	600	Exposure not well-centered; not used
	47006	1993	51	600	
NGC 40	3075	1978	293	1200	
(WC8)	43240	1991	331	1200	
	43241	1991	331	1200	
	46379	1992	335	1200	"Probable" acquisition due to streak
IC 418	3810	1979	5	120	
(O6f)	5077	1979	119	120	
	6651	1979	270	119	
	43170	1991	324	120	
	43171	1991	324	120	
	46377	1992	335	120	
	46378	1992	335	120	
IC 4593	6646	1979	270	150	Nearly saturated; not used
(O7f)	44945	1992	169	240	Crash during read; not used
	44946	1992	169	180	
	44947	1992	169	180	
	47566	1993	118	120	
	47567	1993	119	180	
NGC 2392	4882	1979	97	180	
(O6f)	6470	1979	253	119	
	38292	1990	62	120	
	38295	1990	62	120	
	39824	1990	63	120	
	40130	1990	286	120	
	46375	1992	335	120	
	46376	1992	335	120	
	47011	1993	51	120	
	47012	1993	51	120	

Table 1: CSPN in Fading Study

OBJECT	IMAGE	YEAR	DAY	T (SEC)	COMMENTS
NGC 6891	6648	1979	270	719	
(O3f)	8173	1980	65	600	
	34791	1988	326	600	
	44984	1992	175	1200	
	44985	1992	175	1200	
NGC 6826	16328	1982	45	90	
(O3f)	23537	1984	210	90	
	43042	1991	312	90	
	43043	1991	312	90	
IC 3568	5432	1979	153	1200	
(O5f)	13875	1981	123	900	
	41869	1991	169	900	
	47519	1993	111	900	
	47520	1993	111	900	
	47015	1993	52	900	
	47016	1993	52	900	
NGC 1535	3373	1978	322	165	
(O3)	10737	1980	338	199	
	40076	1990	312		
NGC 1360	3372	1978	322	60	
(sdO)	6085	1979	218	90	
	6618	1979	267	36	
	18044	1982	263	45	
	31590	1987	231	40	
	43238	1991	331	45	
	43239	1991	331	60	
NGC 7009	3128	1978	297	480	
(cont.)	8579	1980	87	180	
	9262	1980	164	300	
	9387	1980	179	420	
	43166	1991	324	480	
	43167	1991	324	480	
NGC 4361	7779	1980	26	300	
(sdO)	19903	1983	125	240	
	44989	1992	175	300	
NGC 7293	4924	1979	102	300	
(wD)	10271			480	
	19832			300	
	22963			360	
	22964			336	
	22967			300	
	43168	1991	324	300	
	43169	1991	324	300	

Table 1: CSPN in Fading Study

OBJECT	IMAGE	YEAR	DAY	T (SEC)	COMMENTS
K1-16	22944	1984	129	540	Highly variable star
(PG 1159)	22945	1984	129	540	
	22946	1984	129	540	
	22947	1984	129	540	
	22948	1984	129	540	
	22949	1984	129	540	
	33848	1984	129	1020	
	33850	1984	129	1260	
	44986	1992	175	1200	
	44987	1992	175	1500	
NGC 3132	3360	1978	320	900	
	22288	1984	48	1200	
	46728	1993	14	1800	
NGC 6543	41865	1991	169	180	
(Of-WR)	41866	1991	169	120	
	46729	1993	14	120	
	46730	1993	15	180	
He 2-108	14181	1981	155	1200	
	17067	1982	150	2700	
	47512	1993	110	2700	
	47513	1993	110	2700	
NGC 3918	18028	1982	62		
	18029	1982	62		
	47514	1993	110	300	
NGC 6058	47521	1993	111	600	
	47522	1993	111	600	
NGC 6572	3200	1978	305	720	
(Of-WR)	3201	1978	305	1080	
	5716	1979	185	720	
	8669	1980	96	900	
	10001	1980	247	1500	
	14652	1981	154	1200	
	14917	1981	247	720	
	14918	1981	249	1200	
	42043	1991	192	1800	
	47523	1993	111	1500	
	47524	1993	112	1500	

Table 1: CSPN in Fading Study

[illegible]

Table 2 Results of Fading Analysis

OBJECT	N	BAND 1 (Å)	dL/dt %/decade	BAND 2 (Å)	dL/dt %/decade	σ_{mag} (%)	σ_{color} (%)
BD +30° 3639 (WC9)	4	1450 ± 25	6.1 ± 0.8	1850 ± 25	4.6 ± 1.8	4.4	1.4
He 2-131 (O7f-eq)	4	"	-4.8 ± 1.5	"	-4.7 ± 1.0	3.9	1.4
He 2-138	4	"	-0.1 ± 3.4	"	-2.4 ± 8.8	6.1	3.0
NGC 40 (WC8)	4	"	-5.0 ± 0.9	"	-0.7 ± 1.3	2.7	2.0
IC 418 (O6f)	6	"	-5.1 ± 3.2	"	-2.3 ± 2.4	6.8	1.9
IC 4593 (O7f)	5	"	-7.4 ± 1.2	"	-4.1 ± 2.5	5.1	1.8
NGC 2392 (O6f)	10	"	-3.2 ± 1.4	"	-4.6 ± 1.3	4.0	0.9
NGC 6891 (O3f)	5	"	1.1 ± 1.8	"	-2.2 ± 2.0	1.3	2.7
NGC 6826 (O3f)	4	"	1.9 ± 5.4	"	-0.4 ± 3.7	3.9	1.0
IC 3568 (O5f)	7	"	-2.4 ± 2.9	"	1.2 ± 2.1	4.2	2.6
NGC 1535 (O3)	3	"	-1.0 ± 0.2	"	1.0 ± 1.2	0.5	0.8
NGC 1360 (sdO)	7	"	-2.4 ± 2.1	"	-0.5 ± 1.1	2.4	1.9
NGC 7009 (cont.)	6	"	-1.7 ± 3.0	"	-1.5 ± 1.6	3.8	1.5
NGC 4361 (sdO)	3	"	3.3 ± 2.0	"	1.4 ± 0.4	1.8	1.1
NGC 3242 (sdO)	5	"	-4.0 ± 1.0	"	-1.6 ± 1.4	2.4	1.7
NGC 7293 (wD)	8	"	0.0 ± 1.5	"	-2.0 ± 1.8	1.5	2.1
NGC 6853 (wD)	2	"	-4.9 ± 0.0	"	2.9 ± 0.0	0.9	3.1
NGC 246	6	"	-3.6 ± 4.2	"	-2.9 ± 2.9	5.1	2.2
K1-16 (PG 1159)	10	"	5.5 ± 1.6	"	4.2 ± 2.2	2.8	1.8
NGC 6543 (Of-WR)	4	"	-76.2 ± 32.5	"	-35.3 ± 24.1	8.1	2.7
He 2-108	4	"	0.5 ± 2.6	"	-2.6 ± 2.8	3.1	1.6
NGC 3918	3	1300 ± 25	-20.1 ± 17.9	"	0.9 ± 7.2	11.6	9.0
NGC 7094	4	1450 ± 25	1.1 ± 1.0	"	-3.4 ± 1.6	1.4	2.1
NGC 6572 (Of-WR)	7	"	-1.7 ± 4.1	"	-7.3 ± 3.5	8.0	3.2
NGC 6210 (O3)	5	"	-3.8 ± 5.1	"	-8.1 ± 7.9	8.9	4.7
Abell 78 (C3-N2)	6	"	-3.1 ± 2.9	"	-1.5 ± 1.4	3.2	1.9

A. Definition of $\chi(k,j)$

Let us consider the following: let the flux in wavelength interval k , at epoch j , be given by f_j^k , with an associated error ϵ_j^k , i.e.,

$$f_j^k = \langle f^k \rangle + \epsilon_j^k, \quad (1)$$

or,

$$\frac{f_j^k}{\langle f^k \rangle} = 1 + \frac{\epsilon_j^k}{\langle f^k \rangle}, \quad (2)$$

where $\langle f^k \rangle = \sum_j f_j^k$. In what follows, we also assume that the relative error is small, so that

$$\frac{\epsilon_j^k}{\langle f^k \rangle} \ll 1. \quad (3)$$

We can take advantage of this last condition to express the (unknown) errors as the natural logarithm of the (known) normalized fluxes. We can see this equivalence by first expanding the exponential function:

$$\exp x = 1 + x + \dots, \quad (4)$$

from which we can write,

$$\ln(1 + x) = x - \dots O(2). \quad (5)$$

Hence, from Eq. (5) we can define the relative error in each interval at each epoch as

$$\chi_j^k \equiv \ln \frac{f_j^k}{\langle f^k \rangle} = \ln \left(1 + \frac{\epsilon_j^k}{\langle f^k \rangle} \right) \approx \frac{\epsilon_j^k}{\langle f^k \rangle}. \quad (6)$$

B. IUE Observing Scripts for Program PNOSH

OBSERVER Altner
 OBJECT NGC 2392
 (1950) 7^h 26^m 13^s.4
 DEC (1950)+21° 00' 56"

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date NOV 29 1992
 Target Serial No. 12

m_v 10.4 Sp. T. 06 f
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 2 min _____ sec Multiple
 Segmented

PROCESSING SPECIFICATIONS	
*** NO DEFAULTS ***	
Processing Type:	
Point Source	_____
Extended (lo disp)	<u>✓</u>
Trailed (lo disp)	_____
Full Aperture (hi disp)	_____
Process Both Apertures _____	
Registration:	
Automatic Shift	<u>✓</u>
Manual Shift	_____
Do Not Shift	_____

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Carini / Loomis

Observatory Record Number 62090

FES 2 Counts Out 392 In 134 Overlap Underlap Blindoffset
 Fast Slow

Tracking Mode FES _____ X Y CT
 FES _____ + GYRO
GYRO

Focus -3.60 Radiation _____ FES 2 Temp 3.1 S/C ROLL 260:34:27.6

BETA 42:30:5.3
 EXPO Start UT Day 335 Hr 3 Min 42 Sec 41 THDA in EXPO 9.8

READ Start UT Day 335 Hr 3 Min 55

LWR extended heater warmup/
 LWR bad scan starts _____

Archive Tape #

IMAGE SEQUENCE NO. SWP 46 ~~375~~

EXPOSURE LEVELS

ission _____ DN, or _____ X OVER
 Continuum 202 DN, or _____ X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

207 minor frames missing.

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OBSERVER Altner

OFFSET STAR

OBJECT

m_v

RA

DEC

PROGRAM ID

PNOSHDate NOV 29 1992Target Serial No. 12ECT NGC 2392
(1950) 7^h 26^m 13^s.4
DEC (1950) +21° 00' 56"m_v 10.4Sp. T. 06 f

E(B-V) _____

Class No. 70

(B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 2 min

_____ sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE %/SEC

3. _____

RA/TO Carini / LoomisObservatory Record Number 62092

FES2 Counts

Out 385In 104Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES

X

Y

CT

FES + GYRO

GYROS/C ROLL 260:34:27.6Focus -3.74

Radiation

FES2 Temp 3.4BETA 42:28:10.2

EXPO Start UT

Day 335Hr 4Min 21Sec 10THDA in EXPO 9.8

READ Start UT

Day 335Hr 4Min 32LWR extended heater warmup/
LWR bad scan starts _____Archive Tape #10745IMAGE SEQUENCE NO. SWP 46376

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

ission _____ DN, or _____ X OVER

Continuum 204 DN, or _____ X OVERBackground 15 DN, or _____ X OVERNoise 2 DN, Y _____ORIGINAL PAGE IS
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OBSERVER

Altner

OFFSET STAR

OBJECT

m_v

RA

DEC

PROGRAM ID

PNCOSH

Date

11/29/92

Target Serial No.

7

CT IC 418
(1950) 05^h 25^m 12^s
DEC (1950) -12° 43' 58"

m_v 9.6

Sp. T. 06f

E(B-V) _____

Class No. 70

(B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time

2 min

_____ sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES

2. _____

TR RATE "/SEC

3. _____

RA/TO Carini / Loomis

Observatory Record Number

62093

FES 2 Counts

Out 960

In 68

Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES

X

Y

CT

FES + GYRO

GYRO

S/C ROLL 204:1:14.3

Focus - 3.60

Radiation -

FES 2 Temp 3.8

BETA 37:30:54.2

EXPO Start UT

Day 335

Hr 5

Min 50

Sec 52

THDA in EXPO

8.8

READ Start UT

Day 335

Hr 6

Min 03

LWR extended heater warmup/
LWR bad scan starts

Archive Tape

#10746

IMAGE SEQUENCE NO. SWP 46377

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Continuum 154 DN, or _____ X OVER
Background 180 DN, or _____ X OVER
Noise 15 DN, or _____ X OVER
2 DN, Y _____

OBSERVER Altner
 OBJECT IC 418
 (1950) 05^h 25^m 12^s
 DEC (1950) -12° 43' 58"

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNC5H
 Date 11/29/92
 Target Serial No. 7

m_v 9.6 Sp. T. 06f
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 2 min _____ sec Multiple
 Segmented

PROCESSING SPECIFICATIONS *** NO DEFAULTS ***	
Processing Type:	
Point Source	☒
Extended (lo disp)	☐
Trailed (lo disp)	☐
Full Aperture (hi disp)	☐
Process Both Apertures	☐
Registration:	
Automatic Shift	☒
Manual Shift	☐
Do Not Shift	☐

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RATO Carini/Loomis

Observatory Record Number 62095

FES 2 Counts Out 976 In 60

Overlap
Fast

Underlap
Slow

Blindoffset

Tracking Mode FES _____ X — Y — CT —
 FES + GYRO
GYRO

S/C ROLL 204: 1: 14.3

Focus -3.75 Radiation — FES 2 Temp 4.1

BETA 37:29:51.3

EXPO Start UT Day 335 Hr 6 Min 29 Sec 40 THDA in EXPO 8.8

READ Start UT Day 335 Hr 6 Min 39

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 10746

IMAGE SEQUENCE NO. SWP 46378

EXPOSURE LEVELS

C III
 Emission 157 DN, or _____ X OVER
 Continuum 180 DN, or _____ X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

OBSERVER Altner
 OBJECT NGC 40
 (1950) 0^h 10^m 16^s.49
 DEC (1950) +72° 14' 38"

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date 11/29/92
 Target Serial No. 1

m_v 10.7 Sp. T. WC8
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 20 min _____ sec Multiple
 Segmented

READ Normal Ping Avoidance Other
 Over-exposure _____ X expected
 REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:
 Point Source ✓
 Extended (lo disp) _____
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift ✓
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)
 1. _____ # PASSES _____
 2. _____ TR RATE "/SEC
 3. _____

RA/TO Carini/Loomis Observatory Record Number 62096
 FES 2 Counts Out In Overlap Underlap Blindoffset
 Fast Slow
 Tracking Mode FES X-186 Y730 CT 3098 F/10
FES 2 + GYRO
 GYRO S/C ROLL 71: 5: 15.3
 Focus -4.42 Radiation _____ FES 2 Temp BETA 61:29:24.0
 EXPO Start UT Day 335 Hr 8 Min 27 Sec 05 THDA in EXPO 7.8

READ Start UT Day 335 Hr 9 Min 14 LWR extended heater warmup/
 LWP bad scan starts _____
 Archive Tape # 10746 IMAGE SEQUENCE NO. SWP 46379

EXPOSURE LEVELS

CTII
 ssion _____ DN, or 1.5 X OVER
 Continuum 156 DN, or _____ X OVER
 Background 19 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

OBSERVER Altner
 OBJECT NGC 40
 (1950) 0^h 10^m 16^s.49
 DEC (1950) +72° 14' 38"

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date 11/29/92
 Target Serial No. 1

m_v 10.7 Sp. T. WCS
 E(B-V) _____ Class No. 70 (B-V) _____

Camera _____ LWP / LWR _____ SWP ✓
 PREP Standard Overexposed _____ Other _____
 Dispersion Mode High Low _____
 Large Aperture Close Open ✓ Lamp _____
 Object Aperture Small Large ✓ Trailed _____
 TOTAL EXPO Time 20 min _____ sec Multiple _____
 Segmented _____

PROCESSING SPECIFICATIONS *** NO DEFAULTS ***	
Processing Type:	
Point Source	<u>✓</u>
Extended (lo disp)	_____
Trailed (lo disp)	_____
Full Aperture (hi disp)	_____
Process Both Apertures	_____
Registration:	
Automatic Shift	<u>✓</u>
Manual Shift	_____
Do Not Shift	_____

READ _____ Normal _____ Ping Avoidance _____ Other _____
 Over-exposure _____ X expected
 REMARKS:

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Carini/Loomis

Observatory Record Number 62098

FES _____ Counts Out _____ In _____

Overlap
Fast

Underlap
Slow

Blindoffset

Tracking Mode FES
FES 2 + GYRO
GYRO

X - 15 /

Y 723

CT

S/C ROLL 71: 8: 59.7

Focus - 3.99 Radiation

FES ² Temp 5.1

BETA 61: 29: 53.1

EXPO Start UT Day 335

Hr 9 Min 45 Sec 19

THDA in EXPO 7.8

READ Start UT Day 335 Hr 10 Min 09

LWR extended heater warmup/
 LWR bad scan starts _____

Archive Tape #10746

IMAGE SEQUENCE NO. SWP 46380

EXPOSURE LEVELS

1.5 DN, or 1.5 X OVER
 Continuum 165 DN, or _____ X OVER
 Background 18 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

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OBSERVER H20P
 OBJECT NGC 3132
 RA (1950) 10 04 55.1
 DEC (1950) -40 11 29

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date 14 Jan 1993
 Target Serial No. 16

m_v 10.20 Sp. T. _____
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR (SWP)
 PREP (Standard) Overexposed Other
 Dispersion Mode High (Low)
 Large Aperture Close (Open) Lamp
 Object Aperture Small (Large) Trailed
 TOTAL EXPO Time 30 min _____ sec Multiple
 Segmented

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:

Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC
 3. _____

RA/TO England / Walker

Observatory Record Number 62646

FES Counts Out 1358* In 1000 (Overlap Fast) Underlap Slow Blindoffset

Tracking Mode FES _____ X Y CT
 FES + GYRO
 GYRO

S/C ROLL 214, 54, 20.8

Focus -1.99 Radiation _____ FES Temp 2.1

BETA 69, 93, 12.6

EXPO Start UT Day 014 Hr 22 Min 36 Sec 25 THDA in EXPO 10.5

READ Start UT Day 014 Hr 23 Min 10

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape 10821

IMAGE SEQUENCE NO. SwP 46728

EXPOSURE LEVELS

Emission 126 C14 DN, or _____ X OVER
 Continuum 105 DN, or _____ X OVER
 Background 22 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

* 1000 cts background

2015/93

OBSERVER Hegp
 OBJECT Ngc 6543
 RA (1950) 17 58 34.2
 DEC (1950) +66 38 05

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSHDate 14 Jan 1993Target Serial No. 28m_v 9.5Sp. T. Of/WR

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 2 min0 sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:

Point Source _____

Extended (lo disp) X

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X

Manual Shift _____

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____ # PASSES _____

2. _____ TR RATE "/SEC

3. _____

RA/TO England / WalkerObservatory Record Number 62647

FES Counts

Out

1448

In

700Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES

X

Y

CT

FES + GYRO

GYROS/C ROLL 204, 39, 10.8Focus -3.95

Radiation -

FES Temp 2.4BETA 89, 53, 53.2EXPO Start UT Day 015Hr 02Min 10Sec 53THDA in EXPO 9.2

READ Start UT

Day 015Hr 02Min 17

LWR extended heater warmup/

LWP bad scan starts _____

Archive Tape 10821IMAGE SEQUENCE NO. SWP 46729

EXPOSURE LEVELS

Emission 185 CIV DN, or _____ X OVERContinuum 110 DN, or _____ X OVERBackground 17 DN, or _____ X OVERNoise 2 DN, Y _____

COMMENTS ON OBSERVATION

700 cnts background17015/93

OBSERVER Heap
 OBJECT NGC 6543
 RA (1950) 17 58 34.2
 DEC (1950) +66 38 05

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date 14 Jan 1993
 Target Serial No. 28

m_v 9.5 Sp. T. Of/WR
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 3 min 0 sec Multiple
 Segmented

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:

Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC
 3. _____

RA/TO England / Walker

Observatory Record Number 62649

FES_ Counts Out 1451 * In 700 Overlap
 Fast Underlap Blindoffset
 Slow

Tracking Mode FES_ X Y CT
 FES_ + GYRO
GYRO

S/C ROLL 204, 39, 10.8

BETA 89, 58, 39.3

Focus - 4.30 Radiation FES_ Temp 2.4

EXPO Start UT Day 015 Hr 02 Min 49 Sec 53 THDA in EXPO 9.5

READ Start UT Day 015 Hr 03 Min 07

LWR extended heater warmup/
 LWR bad scan starts _____

Archive Tape 10821

IMAGE SEQUENCE NO. SWP 46730

EXPOSURE LEVELS

Emission 252 CTX DN, or _____ X OVER
 Continuum 160 DN, or _____ X OVER
 Background 20 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

700 cnts background

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17015/93

OBSERVER AltnerECT Abell 36RA (1950) 13h 37m 57s.4DEC (1950) -19° 37' 47"m_v 11.5Sp. T. Sd07

E(B-V) _____

Class No. 70

(B-V) _____

Camera

LWP / LWR

PREP

Standard ✓

Dispersion Mode

High

Large Aperture

Close

Object Aperture

Small ✓

TOTAL EXPO Time

3 min

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

OFFSET STAR
 OBJECT SAO 158068
 m_v 9.2
 RA 13h 36m 28.7
 DEC -19° 27' 19"

PROGRAM ID PNOSHDate Feb. 19 1993Target Serial No. 22

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source _____

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

x

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift _____

Do Not Shift _____

x

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez / LoomisObservatory Record Number 63018FES 2 CountsOut 363In 260Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES _____

X _____

Y _____

CT _____

FES + GYRO

GYROS/C ROLL 243:17:49.9Focus -1.96

Radiation _____

FES 2 Temp 3.4BETA 59:34:55.1

EXPO Start UT

Day 050Hr 22Min 42Sec 40THDA in EXPO 9.5

READ Start UT

Day 050Hr 23Min 02LWR extended heater warmup/
LWR bad scan starts _____

Archive Tape

10875IMAGE SEQUENCE NO. SWP 47001

EXPOSURE LEVELS

Emission _____ DN, or _____ X OVER

Continuum _____ DN, or 1.5 X OVERBackground 16 DN, or _____ X OVERNoise 2 DN, Y _____

COMMENTS ON OBSERVATION

* Coord. as archived in header are incorrect
 Note: coordinates in Altner
 Catalog are off by ~14"
 - BA 2053/13

OBSERVER AltnerECT Abell 36m (1950) 13h 37m 57.4DEC (1950) -19° 37' 47"

OFFSET STAR
 OBJECT SAO 158068
 m_v 9.2
 RA 13h 36m 28.7
 DEC -19° 27' 19"

m_v 11.5Sp. T. Sd07

E(B-V) _____

Class No. 70

(B-V) _____

Camera

LWP / LWR

SWP ✓

PREP

Standard ✓

Overexposed Other

Dispersion Mode

High

Low ✓

Large Aperture

Close

Open ✓

Lamp

Object Aperture

Small ✓

Large ✓

Trailed

TOTAL EXPO Time

3 min

_____ sec

Multiple
Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROGRAM ID PNOSHDate Feb. 19 1993Target Serial No. 22

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source _____

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift _____

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Loomis/PerezObservatory Record Number 63020FES 2 CountsOut 370In 260Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES _____

X

Y

CT

FES + GYRO

GYROS/C ROLL 243:17:49.9Focus -1.55

Radiation _____

FES 2 Temp 3.4BETA 59:34:40.2

EXPO Start UT

Day 050Hr 23Min 29Sec 49THDA in EXPO 9.5

READ Start UT

Day 051Hr 00Min 30

LWR extended heater warmup/

LWP bad scan starts _____

Archive Tape #

10875

IMAGE SEQUENCE NO.

SWP 47002

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Emission _____ DN, or _____ X OVER

Continuum _____ DN, or 1.5 X OVERBackground 15 DN, or _____ X OVERNoise 2 DN, Y _____

drop outs at very top of
 image, No replay needed
 Mos 3/9)

OBSERVER AltnerJECT He 2-131RA (1950) 15^h 31^m 54.0DEC (1950) -71° 44' 59"

OFFSET STAR
 OBJECT SAC 257357
 m_v 5.7
 RA 16^h 0^m 19.3
 DEC -72 15' 57.25"

PROGRAM ID PNOS14Date Feb 19 1993Target Serial No. 25 m_v 10.3Sp. T. 07f-eq

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 6 min

_____ sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez / LoomisObservatory Record Number 63022FES 2 CountsOut 537In 200Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES _____

X

Y

CT

FES + GYRO

GYROS/C ROLL 257: 9: 52.4Focus -1.83

Radiation. —

FES 2 Temp 3.1BETA 97:35:19.3

EXPO Start UT

Day 051Hr 01Min 05Sec 26THDA in EXPO 9.2

READ Start UT

Day 051Hr 1Min 21LWR extended heater warmup/
LWP bad scan starts _____

Archive Tape

10875IMAGE SEQUENCE NO. SWP 47003

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Mission _____ DN, or _____ X OVER

Continuum 187 DN, or _____ X OVERBackground 16 DN, or _____ X OVERNoise 2 DN, Y _____

M053113

OBSERVER Altner

OFFSET STAR
 OBJECTSAC 257357
 m_v 5.7
 RA 16^h 0^m 19^s.3
 DEC -72 15' 57".25

PROGRAM ID PNCSIHDate Feb 19 1993Target Serial No. 25

ECT H_c 2-131
 (1950) 15^h 31^m 54.0
 DEC (1950) -71[°] 44' 59"

 m_v 10.3Sp. T. 07f-eg

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

PREP

Standard ☒SWP ☒

Dispersion Mode

High

Overexposed Other

Large Aperture

Close

Low ☒

Object Aperture

Small ☒Open ☒

TOTAL EXPO Time

6 minLarge ☒

Lamp

Trailed

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp) ☒

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift ☒

Manual Shift _____

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez / LoomisObservatory Record Number 63023

FES2 Counts

Out 527In 230Overlap
Fast ☒

Underlap

Slow

Blindoffset

Tracking Mode

FES

X-610Y 703CT 731 F/6FES2 + GYRO
GYROS/C ROLL 257.9.52.4Focus - 2.49

Radiation —

FES2 Temp 2.8BETA 97.33.1.0

EXPO Start UT

Day 051Hr 2Min 41Sec 58THDA in EXPO 9.8

READ Start UT

Day 051Hr 3Min 17LWR extended heater warmup/
LWR bad scan starts _____

Archive Tape

10876IMAGE SEQUENCE NO. SWP 47004

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Mission _____ DN, or _____ X OVER

Continuum 191 DN, or _____ X OVERBackground 16 DN, or _____ X OVERNoise 2 DN, Y _____M053/93

OBSERVER Altner
 ECT He 2-138
 (1950) 15° 51' 18.9"
 DEC (1950) -66° 00' 26"

OFFSET STAR
 OBJECT SAO 253350
 m_v 8.6
 RA 15° 51' 29.4"
 DEC -65° 23' 20"

PROGRAM ID PNOSH
 Date Feb 19 1993
 Target Serial No. 24

m_v 11.0 Sp. T. _____
 E(B-V) _____ Class No. 70 (B-V) _____

Camera _____ LWP / LWR SWP
 PREP Standard Overexposed _____ Other _____
 Dispersion Mode High Low
 Large Aperture Close Open Lamp _____
 Object Aperture Small Large Trailed _____
 TOTAL EXPO Time 10 min _____ sec Multiple _____
 Segmented _____

PROCESSING SPECIFICATIONS	
*** NO DEFAULTS ***	
Processing Type:	
Point Source	_____
Extended (lo disp)	<u>X</u>
Trailed (lo disp)	_____
Full Aperture (hi disp)	_____
Process Both Apertures	_____
Registration:	
Automatic Shift	<u>X</u>
Manual Shift	_____
Do Not Shift	_____

READ _____ Normal _____ Ping Avoidance _____ Other _____
 Over-exposure _____ X expected _____
 REMARKS: _____

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Perez/Loomis

Observatory Record Number 63024

FES 2 Counts Out 397

In 192

Overlap
Fast

Underlap
Slow

Blindoffset

Tracking Mode

FES
FES 2 + GYRO
GYRO

X -984

Y 1367

CT 178 F/0

S/C ROLL 260: 47: 3.8

BETA 98: 8: 23.1

Focus -2.81

Radiation _____

FES 2 Temp 2.4

EXPO Start UT

Day 051

Hr 3

Min 43

Sec 08

THDA in EXPO 9.8

READ Start UT

Day 051

Hr 4

Min 16

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape

#10876

IMAGE SEQUENCE NO. SWP 47005

EXPOSURE LEVELS

ission _____ DN, or _____ X OVER
 Continuum 120 DN, or _____ X OVER
 Background 17 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

* Exptn didn't get run
 Exposure not well centered
 in Aperture. OFF in Y direction
 2/25/93

OBSERVER Altner
 ECT H2 2-138
 (1950) 15^h 51^m 12^s
 DEC (1950) -66° 00' 26"

OFFSET STAR
 OBJECT SAO 253350
 m_v 8.6
 RA 15^h 51^m 24^s.4
 DEC -65° 23' 20"

PROGRAM ID PNC5HDate Feb 19 1993Target Serial No. 24 m_v 11.0

Sp. T. _____

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 10 min

_____ sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

X

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

XOFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez/LoomisObservatory Record Number 63025FES 2 CountsOut 396In 200Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES

X - 989Y 1350CT 180 F/0FES 2 + GYRO

GYRO

S/C ROLL 260:47:3.8Focus -3.57

Radiation _____

FES 2 Temp 2.4BETA 98:6:33.8

EXPO Start UT

Day 051Hr 4Min 40Sec 46THDA in EXPO 10.2

READ Start UT

Day 051Hr 4Min 51LWR extended heater warmup/
LWP bad scan starts _____

Archive Tape

10876IMAGE SEQUENCE NO. SWP 47006

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Mission _____ DN, or _____ X OVER

Continuum 241 DN, or _____ X OVERBackground 15 DN, or _____ X OVERNoise 2 DN, Y _____2053/13

OBSERVER Altner
 OBJECT NGC 2392
 (1950) 7^h 26^m 13.^s4
 DEC (1950) 21° 00' 56"

OFFSET STAR
 OBJECT SHO 79428
 m_v 8.3
 RA 7, 26, 13.6
 DEC 21, 2, 35.9

PROGRAM ID PNASHDate 2/20/93Target Serial No. 12 m_v 10.4Sp. T. 06 f

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP ☒

PREP

Standard ☒

Overexposed Other

Dispersion Mode

High

Low ☒

Large Aperture

Close

Open ☒

Lamp

Object Aperture

Small

Large ☒

Trailed

TOTAL EXPO Time 2 min

_____ sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source _____

Extended (lo disp) ☒

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift ☒

Manual Shift _____

Do Not Shift _____

OFFSET REF. PTS.
(FESX, FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez / LoomisObservatory Record Number 630289FES 2 CountsOut 439In 183Overlap
Fast

Underlap

Blindoffset

Slow

Tracking Mode

FES _____

X -

Y -

CT -

FES + GYRO

GYRO

S/C ROLL 82:38:55.4Focus -5.11 Radiation _____ FES 2 Temp 1.7BETA 41:38:33.1EXPO Start UT Day 051 Hr 22 Min 13 Sec 00 THDA in EXPO 10.5READ Start UT Day 051 Hr 22 Min 16LWR extended heater warmup/
LWP bad scan starts _____Archive Tape #10877IMAGE SEQUENCE NO. SWP 47011

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Emission _____ DN, or _____ X OVER

Continuum 215 DN, or _____ X OVERBackground 15 DN, or _____ X OVERNoise 2 DN, Y _____

2053/13

OBSERVER Altner
 OBJECT NGC 2392
 (1950) 7^h 26^m 13^s.4
 DEC (1950) +21^h 00' 56"

OFFSET STAR
 OBJECT SAG 79422
 m_v 8.3
 RA 7^h 26^m 13^s.64
 DEC 21° 2' 35".99

PROGRAM ID PNOSH
 Date 2/20/93
 Target Serial No. 12

m_v 10.4 Sp. T. 06f
 E(B-V) _____ Class No. 70 (B-V) _____

Camera _____ LWP / LWR _____ SWP ☒
 PREP Standard ☒ Overexposed _____ Other _____
 Dispersion Mode High Low ☒
 Large Aperture Close Open ☒ Lamp _____
 Object Aperture Small Large ☒ Trailed _____
 TOTAL EXPO Time 2 min _____ sec Multiple _____
 Segmented _____

READ _____ Normal _____ Ping Avoidance _____ Other _____
 Over-exposure _____ X expected _____
 REMARKS: _____

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:
 Point Source _____
 Extended (lo disp) ☒
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift ☒
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Perez / Loomis

Observatory Record Number 63030

FES 2 Counts Out 433 In 148 ☒ Overlap Fast Underlap Slow Blindoffset

Tracking Mode FES _____ X — Y — CT —
 FES + GYRO
☒ GYRO

Focus -3.54 Radiation _____ FES 2 Temp 1.7 S/C ROLL 82:38:55.4

BETA 71:39:49.0
 EXPO Start UT Day 051 Hr 22 Min 42 Sec 58 THDA in EXPO 10.8

READ Start UT Day 051 Hr 22 Min 51

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape #10877

IMAGE SEQUENCE NO. SWP 47012

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Transmission _____ DN, or _____ X OVER
 Continuum 215 DN, or _____ X OVER
 Background 16 DN, or _____ X OVER
 Noise 2 DN, Y _____

2050193

OBSERVER AltnerOBJECT NGC 6210(1950) 16^h 42^m 23^s.7DEC (1950) 23° 53' 29"9.9E(B-V) Sp. T. S103Class No. 70 (B-V)

Camera

LWP / LWR

PREP

Standard

Dispersion Mode

High

Large Aperture

Close

Object Aperture

Small

TOTAL EXPO Time 6 min

OFFSET STAR

OBJECT SAD 84574m_v 7.3RA 16^h 42^m 56^s.4DEC 23° 48' 29".8PROGRAM ID PNASHDate 2/20/93Target Serial No. 27

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

READ

Normal

Ping Avoidance

Other

Over-exposure X expected

REMARKS:

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. # PASSES 2.

TR RATE "/SEC

3. RA/TO Perez / LoomisObservatory Record Number 63031FES 2 CountsOut 1792In 380Overlap
Fast

Underlap

Blindoffset

Slow

Tracking Mode

FES

X 337Y 850CT 413 F/10FES 2 + GYRO

GYRO

S/C ROLL 257:21:20.3Focus -2.34Radiation FES 2 Temp 1.7

BETA

91:43:56.0

EXPO Start UT

Day 052Hr 1Min 20Sec 51

THDA in EXPO

10.2

READ Start UT

Day 052Hr 1Min 36

LWR extended heater warmup/

LWP bad scan starts

Archive Tape

10877

IMAGE SEQUENCE NO.

SWP 47013

EXPOSURE LEVELS

Emission CM130

DN, or

X OVER

Continuum

160

DN, or

X OVER

Background

15

DN, or

X OVER

Noise

2

DN, Y

COMMENTS ON OBSERVATION

Broke track during expo.
due to Scattered light.

Errors after expo.

EX = 9, EY = 47-53/93

OBSERVER Altner
 OBJECT NGC 6210
 (1950) 16^h 42^m 23.7^s
 DEC (1950) 23° 53' 29"

OFFSET STAR
 OBJECT SA 84574
 m_v 7.3
 RA 16^h 42^m 56.4^s
 DEC 23° 48' 29.8"

PROGRAM ID PNCENDate 2/20/93Target Serial No. 27 m_v 9.9Sp. T. 803

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP ✓

PREP

Standard ✓

Overexposed Other

Dispersion Mode

High

Low ✓

Large Aperture

Close

Open ✓

Lamp

Object Aperture

Small

Large ✓

Trailed

TOTAL EXPO Time 6 min

_____ sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source _____

Extended (lo disp) X

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X

Manual Shift _____

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Perez / LoomisObservatory Record Number 63033FES 2 CountsOut 787In 359Overlap
Fast

Underlap

Blindoffset

Slow

Tracking Mode

FES _____

X —

Y —

CT —

FES + GYRO

GYROS/C ROLL 257:21:20.3Focus -2.68

Radiation _____

FES 2 Temp 1.7BETA 91:41:42.9

EXPO Start UT

Day 052Hr 2Min 08Sec 14THDA in EXPO 10.2

READ Start UT

Day 052Hr 2Min 27

LWR extended heater warmup/

LWP bad scan starts _____

Archive Tape

10877IMAGE SEQUENCE NO. SWP 47014

EXPOSURE LEVELS

Emission

144

DN, or _____ X OVER

Continuum

161

DN, or _____ X OVER

Background

15

DN, or _____ X OVER

Noise

2

DN, Y _____

COMMENTS ON OBSERVATION

253/93

OBSERVER Altner

ECT NGC 3562

(1950) 12^h 31^m 46^s.6

DEC (1950) 82° 50' 22"

OFFSET STAR
OBJECT SAC 2060
m_v 9.1
RA 12^h 31^m 38^s.4
DEC 82° 51' 43^s.1

PROGRAM ID PNOCH

Date 2/26/93

Target Serial No. 20

m_v 11.5

Sp. T. 05 f

E(B-V) _____

Class No. 70

(B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed

Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time

15 min

sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Brez / Loomis

Observatory Record Number 63034

FES 2 Counts

Out 660

In 550

Overlap
Fast

Underlap
Slow

Blindoffset

Tracking Mode

FES

X

Y

CT

FES + GYRO

GYRO

S/C ROLL 324:57:54.4

Focus -234

Radiation

FES 2 Temp 1.7

BETA 73:18:58.0

EXPO Start UT

Day 052

Hr 3

Min 33

Sec 46

THDA in EXPO 10.2

READ Start UT

Day 052

Hr 4

Min 04

LWR extended heater warmup/
LWP bad scan starts

Archive Tape #10871

IMAGE SEQUENCE NO. SWP 47013

EXPOSURE LEVELS

Continuum 168 DN, or _____ X OVER

Background 20 DN, or _____ X OVER

Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

Errors After exposure: $E_x = 12$, $E_y = 4$

m=53/13

OBSERVER A. Ithier

OFFSET STAR

OBJECT S40 2060

m_v 9.1
 RA 12^h 35^m 32.4^s
 DEC 82° 51' 43.1"

PROGRAM ID PNOCHDate 2/26/93Target Serial No. 20

ECT NGC 3568
 (1950) 12^h 31^m 46.6^s
 DEC (1950) 82° 50' 22"

 m_v 11.5Sp. T. 05f

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 15 min

_____ sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source

Extended (lo disp)

Trailed (lo disp)

Full Aperture (hi disp)

Process Both Apertures

Registration:

Automatic Shift

Manual Shift

Do Not Shift

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RA/TO Perez / LoomisObservatory Record Number 63036FES 2 CountsOut 671In 525Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES _____

X _____

Y _____

CT _____

FES + GYRO

GYROS/C ROLL 324:57:54.4Focus - 2.34

Radiation

FES 2 Temp 1.7BETA 73:20:26.6

EXPO Start UT

Day 052Hr 4Min 33Sec 02THDA in EXPO 10.5

READ Start UT

Day 052Hr 4Min 48LWR extended heater warmup/
LWR bad scan starts _____

Archive Tape

10877IMAGE SEQUENCE NO. SWP 47016

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

CTIII 180 DN, or _____ X OVER
 Continuum 175 DN, or _____ X OVER
 Background 18 DN, or _____ X OVER
 Noise 2 DN, Y _____

2053/93

OBSERVER Altner
CT He 2-108RA (1950) 14^h 14^m 47.5^s
DEC (1950) -51° 56' 50"OFFSET STAR
OBJECT SAO 241622
m_v 8.1
RA 14^h 15^m 20.0^s
DEC -52° 00' 25"PROGRAM ID PNOSHDate April 20, 1993Target Serial No. 24m_v 12.5

Sp. T. _____

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

StandardOverexposed Other _____

Dispersion Mode

HighLow

Large Aperture

CloseOpen

Lamp

Object Aperture

SmallLarge

Trailed

TOTAL EXPO Time 45 min0 sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

MARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source ☒

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift ☒

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Rawley/SnellObservatory Record Number 63727FES 2 CountsOut 175In 129Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES _____

X 523Y -1455CT 1979 F6FES 2 + GYRO
GYROS/C ROLL 183,26,4.9Focus -3.08

Radiation

FES 2 Temp 2.1BETA 40,41,12.8

EXPO Start UT

Day 110Hr 21Min 27Sec 03THDA in EXPO 9.2

READ Start UT

Day 110Hr 22Min 22LWR extended heater warmup/
LWP bad scan starts _____

Archive Tape

10989IMAGE SEQUENCE NO. SWP 47512

EXPOSURE LEVELS

Emission C IV 122 DN, or _____ X OVERContinuum 129 DN, or _____ X OVERBackground 24 DN, or _____ X OVERNoise 2 DN, Y _____

COMMENTS ON OBSERVATION

2111/93

OBSERVER AltnerECT He 2-108RA (1950) 14^h. 14^m 47.^s5DEC (1950) -51° 56' 50"m_v 12.5

Sp. T. _____

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 45 min

0

sec Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

MARKS:

OFFSET STAR

OBJECT

m_v

RA

DEC

PROGRAM ID PNO SHDate April 20, 1993Target Serial No. 24PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:

Point Source ☒

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift ☒

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Rawley/SnellObservatory Record Number 63729FES 2 Counts Out 168In 137Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES

X 524Y -1455CT 2011 F/OFES 2 + GYRO
GYROS/C ROLL 188,26,4.9Focus -2.02

Radiation

FES 2 Temp 2.4BETA 40,39,34.9

EXPO Start UT

Day 110Hr 22Min 51Sec 55THDA in EXPO 9.8

READ Start UT

Day 110Hr 23Min 39LWR extended heater warmup/
LWR bad scan starts _____

Archive Tape

10989IMAGE SEQUENCE NO. SWP 47513

EXPOSURE LEVELS

Emission 107 DN, or _____ X OVERContinuum 122 DN, or _____ X OVERBackground 22 DN, or _____ X OVERNoise 2 DN, Y _____

COMMENTS ON OBSERVATION

2111/93

OBSERVER Altner

OFFSET STAR

OBJECT

m_v

RA

DEC

PROGRAM ID PNASHDate APRIL 20 1993 (Apr. 21 UT)Target Serial No. 18ECT NGC 3918
RA (1950) 11^h 47^m 50^s
DEC (1950) -56° 54' 10"m_v 10.8

Sp. T. _____

E(B-V) _____

Class No. 70 (B-V) 0.01

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

HighLow

Large Aperture

CloseOpen

Lamp

Object Aperture

SmallLarge

Trailed

TOTAL EXPO Time 5 min0 sec

Multiple

Segmented

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

MARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source ☒

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift ☒

Do Not Shift _____

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Rawley/SnellObservatory Record Number 63730FES 2 CountsOut 796In 188Overlap
Fast

Underlap

Slow

Blindoffset

Tracking Mode

FES _____

X

Y

CT

FES + GYRO

GYROS/C ROLL 139, 23, 52.4Focus -0.98

Radiation

FES 2 Temp 2.4BETA 51, 17, 33.7

EXPO Start UT

Day 111Hr 00Min 18Sec 58THDA in EXPO 10.2

READ Start UT

Day 111Hr 00Min 37LWR extended heater warmup/
LWP bad scan starts _____

Archive Tape

10989IMAGE SEQUENCE NO. SWP 47514

EXPOSURE LEVELS

Emission _____ DN, or 3 X OVERContinuum 40 DN, or _____ X OVERBackground 14 DN, or _____ X OVERNoise 2 DN, Y _____

COMMENTS ON OBSERVATION

EX, EY = (1, 0)

C IV : 203 DN

He II : 185 DN

211/173

OBSERVER Altner
ECT NGC 3568RA (1950) 12^h 31^m 46^s.6
DEC (1950) 82° 50' 22"OFFSET STAR
OBJECT SAO 2060
m_v 9.1
RA 12^h 35^m 38^s.4
DEC +82° 51' 43"PROGRAM ID PNOSHDate 4/21/93Target Serial No. 20m_v 11.5Sp. T. 65 f

E(B-V) _____

Class No. 70 (B-V) _____

Camera

LWP / LWR

SWP

PREP

Standard

Overexposed Other

Dispersion Mode

High

Low

Large Aperture

Close

Open

Lamp

Object Aperture

Small

Large

Trailed

TOTAL EXPO Time 15 min

_____ sec Multiple

Segmented

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source ✓

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift ✓

Do Not Shift _____

READ

Normal

Ping Avoidance

Other

Over-exposure _____ X expected

MARKS:

OFFSET REF. PTS.
(FESX , FESY)

TRAILS

1. _____

PASSES _____

2. _____

TR RATE "/SEC

3. _____

RA/TO Rawley / Schlegel, WalkerObservatory Record Number 63735

FES_ Counts Out

In

Overlap
FastUnderlap
Slow

Blindoffset

Tracking Mode

FES_

X -1213Y 921

CT

1564 1608 F/0~~FES2 + GYRO~~GYRO

S/C ROLL

20 34 34Focus -5.56

Radiation _____

FES_ Temp

3.4

BETA

95 10 4.5

EXPO Start UT

Day 111Hr 18Min 23Sec 46

THDA in EXPO

9.2

READ Start UT

Day 111Hr 18Min 47

LWR extended heater warmup/

LWP bad scan starts _____

Archive Tape

10990IMAGE SEQUENCE NO. SWP 47519

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Mission 187 DN, or _____ X OVERContinuum 172 DN, or _____ X OVERBackground 39 DN, or _____ X OVERNoise 2 DN, Y _____frack broken, object may have
been out of aperture for one minute
returnal to gyros about 7 minutes into
exposure
2112/13

RIVER Altner
 OBJECT NGC 3568
 RA (1950) $12^h 31^m 46^s.6$
 DEC (1950) $82^\circ 50' 22''$

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH

Date 4/21/93

Target Serial No. 20

m_v 11.5

Sp. T. 05f

E(B-V) _____

Class No. 70

(B-V) _____

Camera _____ LWP / LWR Standard SWP ✓
 PREP _____ Overexposed Other _____
 Dispersion Mode _____ High Low ✓
 Large Aperture _____ Close Open ✓ Lamp _____
 Object Aperture _____ Small Large ✓ Trailed _____
 TOTAL EXPO Time 15 min _____ sec Multiple _____
 Segmented _____

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:
 Point Source ✓
 Extended (lo disp) _____
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift _____
 Manual Shift ✓
 Do Not Shift _____

READ _____ Normal _____ Ping Avoidance _____ Other _____

Over-exposure _____ X expected

ARKS:

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RA/TO Rawley / Schlegel, Walker

Observatory Record Number 63737

FES_ Counts Out In

Overlap
 Fast

Underlap
 Slow

Blindoffset

Tracking Mode FES_ X Y
FES_ + GYRO
GYRO

CT 1301 F/0 of offset star @ X=100%

S/C ROLL 20 34 33.5 Y=100%

Focus -65.90 Radiation _____ FES 2 Temp 3.4

BETA 95 10 49.3

EXPO Start UT Day 111 Hr 19 Min 23 Sec 51 THDA in EXPO 9.2

READ Start UT Day 111 Hr 19 Min 57

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape 10990

IMAGE SEQUENCE NO. SWP 47520

OSURE LEVELS

Emission 201 CU DN, or _____ X OVER
 Continuum 212 DN, or _____ X OVER
 Background 26 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

23 112/13

OBSERVER Altner
 ICT NGC 6058
 RA (1950) 16^h 02^m 42^s
 DEC (1950) 40° 49' 04"

OFFSET STAR
 OBJECT SAO 64988
 m_v 6.4
 RA 15, 55, 43.8
 DEC +39, 50, 16

PROGRAM ID PNOSHDate April 21 1993Target Serial No. 55

m_v 13.5 Sp. T. cont
 E(B-V) _____ Class No. 70 (B-V) _____

Camera _____ LWP / LWR _____ SWP ✓
 PREP Standard Overexposed _____ Other _____
 Dispersion Mode High Low ✓
 Large Aperture Close Open ✓ Lamp _____
 Object Aperture Small Large ✓ Trailed _____
 TOTAL EXPO Time 10 min _____ sec Multiple _____
 Segmented _____

PROCESSING SPECIFICATIONS
*** NO DEFAULTS ***

Processing Type:

Point Source ✓
 Extended (lo disp) _____
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____
 Manual Shift ✓
 Do Not Shift _____

READ _____ Normal _____ Ping Avoidance _____ Other _____
 Over-exposure _____ X expected _____

MARKS: 2nd offset star SAO 45874

OFFSET REF. PTS.
(FESX, FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RA/TO Rawley / Schlegel, WalkerObservatory Record Number 63738

FES _____ Counts Out _____ In _____ Overlap _____ Underlap Blindoffset
 Fast _____ Slow _____

Tracking Mode FES _____ X _____ Y _____
 FES _____ + GYRO
GYRO

CT 848 F10S/C ROLL 323 43 5.5Focus -5.47 Radiation _____ FES 2 Temp 3.1BETA 60 18 27.4

EXPO Start UT Day 111 Hr 21 Min 10 Sec 59 THDA in EXPO 9.2

READ Start UT Day 111 Hr 21 Min 55 31 LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape 10990IMAGE SEQUENCE NO. SWP 47521

EXPOSURE LEVELS

ission _____ DN, or _____ X OVER
 Continuum 200 DN, or _____ X OVER
 Background 12 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

$E_x, E_y = -1, 0$
 at offset star
2112/93

G RYER *Altner*
 C. JT NGC 6058
 RA (1950) $16^h 02^m 42^s$
 DEC (1950) $40^\circ 49'$

OFFSET STAR
 OBJECT *SAO 64988*
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date April 21 1993
 Target Serial No. 55

m_v 13.5 Sp. T. cont
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 10 min _____ sec Multiple
 Segmented

READ Normal Ping Avoidance Other
 Over-exposure _____ X expected
 ARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:
 Point Source ✓
 Extended (lo disp) _____
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift _____
 Manual Shift ✓
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)
 1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RA/TO *Rawley/Schlegel, Walker*

Observatory Record Number 63740

FES_ Counts Out In

Overlap
Fast

Underlap
Slow

Blindoffset

Tracking Mode FES_ X Y CT
 FES_ + GYRO
GYRO

S/C ROLL 323, 43, 5.5

Focus - 3.91 Radiation _____ FES_ Temp 3.1

BETA 60, 25, 20.7

EXPO Start UT Day 111 Hr 22 Min 00 Sec 14 THDA in EXPO 9.5

READ Start UT Day 111 Hr 22 Min 11

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape 10990

IMAGE SEQUENCE NO. SWP 47522

DSURE LEVELS

COMMENTS ON OBSERVATION

Emission _____ DN, or _____ X OVER
 Continuum 158 DN, or _____ X OVER
 Background 14 DN, or _____ X OVER
 Noise 2 DN, Y _____

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21112/93

OBSERVER Altner
 CT NGC 6572
 RA (1950) 18^h 09^m 40^s.6
 DEC (1950) +06° 50' 25"

OFFSET STAR
 OBJECT SAO 123243
 ~~m_v 8.7~~
~~RA 18^h 09^m 51^s.827~~
~~DEC +06 51' 00".7~~

PROGRAM ID PNOSHDate (UT) 4/21/93Target Serial No. 29

m_v 9 Sp. T. PN
 E(B-V) 0.20 Class No. 70 (B-V) _____

Camera _____ LWP / LWR SWP
 PREP Standard Overexposed _____ Other _____
 Dispersion Mode High Low
 Large Aperture Close Open Lamp _____
 Object Aperture Small Large Trailed _____
 TOTAL EXPO Time 25 min _____ sec Multiple _____
 Segmented _____

PROCESSING SPECIFICATIONS	
*** NO DEFAULTS ***	
Processing Type:	
Point Source	☒
Extended (lo disp)	☐
Trailed (lo disp)	☐
Full Aperture (hi disp)	☐
Process Both Apertures	☐
Registration:	
Automatic Shift	☐
Manual Shift	☒
Do Not Shift	☐

READ Normal Ping Avoidance _____ Other _____

Over-exposure _____ X expected

MARKS: Used offset star SAO 123353, $m_v=5.6$
18^h 16^m 44^s.2 +7° 14' 17"

OFFSET REF. PTS. (FESX , FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Rawley/Schlegel, WalkerObservatory Record Number 63746FES _____ Counts Out 1598 In _____

Overlap
Fast

Underlap
SlowBlindoffset

Reference
 Pnt. used: (a) X=1008, Y=1008
 (if non-standard)

Tracking Mode FES2 + GYRO GYRO

X

Y

CT

Focus -3.06 FES2 Temp 3.1 BETA 65 48 53.0 S/C ROLL 286 22 58.8EXPO Start UT Day 111 Hr 23 Min 04 Sec 53 THDA in EXPO 9.5READ Start UT Day 111 Hr 23 Min 50

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 10990IMAGE SEQUENCE NO. SWP 47523

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Emission CTII DN, or 3x X OVERContinuum 223 208 DN, or _____ X OVERBackground 35.15 DN, or _____ X OVERNoise 3.2 DN V

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2112/93

OBSERVER Altner
 OBJECT NGC 6572
 (1950) 18^h 09^m 40^s.6
 DEC (1950) +06° 50' 25"

OFFSET STAR
 OBJECT SAO 123 243
 m_v 8.7
 RA 18^h 09^m 54^s.827
 DEC +06 51' 00".7

PROGRAM ID PNOSH

Date (UT) 4/21/93

Target Serial No. 29

m_v 9

Sp. T. PN

E(B-V) 0.20

Class No. 70 (B-V) _____

Camera _____ LWP / LWR _____

PREP Standard

Dispersion Mode High

Large Aperture Close

Object Aperture Small

TOTAL EXPO Time 25 min

SWP

Overexposed Other

Low

Open

Lamp

Large

Trailed

Multiple

Segmented

READ _____ Normal _____ Ping Avoidance _____ Other _____

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:

Point Source ✓

Extended (lo disp) _____

Trailed (lo disp) _____

Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift _____

Manual Shift ✓

Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____

2. _____ TR RATE "/SEC _____

3. _____

RA/TO Rawley/Schlegel

Observatory Record Number 63742

FES _____ Counts Out 1583 In _____

Overlap
Fast

Underlap
 Slow

Blindoffset

Reference

Pnt. used: 1008, 1008

(if non-standard)

Tracking Mode FES 2 + GYRO GYRO

X

Y

CT

Focus -2.30 FES 2 Temp _____ BETA 65 40 52.0 S/C ROLL 286 22 58.8

EXPO Start UT Day 112 Hr 00 Min 20 Sec 00 THDA in EXPO 9.5

READ Start UT Day 112 Hr 00 Min 47

LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 10990

IMAGE SEQUENCE NO. SWP 47524

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

Emission 217 C IV DN, or _____ X OVER

Continuum 195 DN, or _____ X OVER

Background 21 DN, or _____ X OVER

Noise 2 DN, Y _____

M 112 (13)

OBSERVER Heap
 OBJECT NGC 6210
 (1950) 16 42 24.0
 DEC (1950) +23 54 00

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH
 Date (UT) 28 April 1993
 Target Serial No. 27

m_v 9.5 Sp. T. (sd) 0
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR (SWP)
 PREP (Standard) Overexposed Other
 Dispersion Mode High (Low)
 Large Aperture Close (Open) Lamp
 Object Aperture Small (Large) Trailed
 TOTAL EXPO Time 16 min 0 sec Multiple
 Segmented

READ (Normal) Ping Avoidance Other
 Over-exposure _____ X expected
 REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:
 Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS. (FESX, FESY)	TRAILS
1. _____	# PASSES _____
2. _____	TR RATE "/SEC _____
3. _____	_____

RA/TO Rawley / Groehner

Observatory Record Number 63814

FES Counts Out 657 In 244 (Overlap Fast) Underlap Slow Blindoffset

Reference
 Pnt. used:
 (if non-standard)

Tracking Mode (FES + GYRO) GYRO

Focus -2.10 FES Temp 2.1 BETA 51,10,34.3 X -590 Y -882 CT 773 F/10
 S/C ROLL 314, 24, 56

EXPO Start UT Day 118 Hr 21 Min 32 Sec 43 THDA in EXPO 9.2

READ Start UT Day 118 Hr 21 Min 58 LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 11002

IMAGE SEQUENCE NO. SWP 47564

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

mission _____ DN, or 2 NI X OVER
 Continuum _____ DN, or 2 X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

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OBSERVER Heap
 OBJECT NOC 6210
 (1950) 16 42 23.7
 DEC (1950) +23 53 29

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNOSH

Date (UT) 28 April 1993

Target Serial No. 27

m_v 9.5

Sp. T. (sd)0

E(B-V) _____

Class No. 70

(B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 16 min 0 sec Multiple
8 min Segmented

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS

*** NO DEFAULTS ***

Processing Type:

Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RA/TO Rawley / Groebner

Observatory Record Number 63816

FES Counts Out 633 In 188

Overlap
 Fast

Underlap
 Slow

Blindoffset

Reference
 Pnt. used:
 (if non-standard)

Tracking Mode FES + GYRO GYRO

X -592 Y -882 CT 729 F/0

Focus -1.78 FES Temp 2.1 BETA 51, 9, 13.7 S/C ROLL 314, 24, 56

EXPO Start UT Day 118 Hr 22 Min 30 Sec 05 THDA in EXPO 9.8

READ Start UT Day 118 Hr 23 Min 15

LWR extended heater warmup/
 LWR bad scan starts _____

Archive Tape # 11002

IMAGE SEQUENCE NO. SWP 47565

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

mission 232 NV DN, or _____ X OVER
 Continuum 211 DN, or _____ X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

Si III 180DN

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OBSERVER Heap
 OBJECT IC 4593
 (1950) 16 09 23.3
 DEC (1950) +12 12 08

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNGSH
 Date (UT) 28 April 1993
 Target Serial No. 26

m_v 10.6 Sp. T. 07 f
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 2 min 30 sec Multiple
 Segmented

READ Normal Ping Avoidance Other
 Over-exposure _____ X expected
 REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:
 Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:
 Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC _____
 3. _____

RATO Rawley / Groebner

Observatory Record Number 63817

FES Counts Out 407 In 212 Overlap Underlap Blindoffset
 Fast Slow

Reference
 Pnt. used:
 (if non-standard)

Tracking Mode FES + GYRO GYRO

X Y CT

Focus - 2.33 FES Temp 2.4 BETA 37, S/C ROLL 314, 10, 33

EXPO Start UT Day 118 Hr 23 Min 41 Sec 54 THDA in EXPO 9.8

READ Start UT Day 118 Hr 23 Min 47 LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 11002

IMAGE SEQUENCE NO. SWP 47566

EXPOSURE LEVELS

_____ DN, or _____ X OVER
 Continuum 160 DN, or _____ X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

COMMENTS ON OBSERVATION

5x 54 = 0.1

11-1-3

OBSERVER Hzap
 OBJECT IC 4593
 (1950) 16 09 23.3
 DEC (1950) 12 12 08

OFFSET STAR
 OBJECT
 m_v
 RA
 DEC

PROGRAM ID PNCOSH
 Date (UT) 28 April 1993
 Target Serial No. 26

m_v 10.6 Sp. T. 07f
 E(B-V) _____ Class No. 70 (B-V) _____

Camera LWP / LWR SWP
 PREP Standard Overexposed Other
 Dispersion Mode High Low
 Large Aperture Close Open Lamp
 Object Aperture Small Large Trailed
 TOTAL EXPO Time 3 min 30 sec Multiple
 Segmented

READ Normal Ping Avoidance Other

Over-exposure _____ X expected

REMARKS:

PROCESSING SPECIFICATIONS
 *** NO DEFAULTS ***

Processing Type:

Point Source _____
 Extended (lo disp) X
 Trailed (lo disp) _____
 Full Aperture (hi disp) _____

Process Both Apertures _____

Registration:

Automatic Shift X
 Manual Shift _____
 Do Not Shift _____

OFFSET REF. PTS.
 (FESX , FESY)

TRAILS

1. _____ # PASSES _____
 2. _____ TR RATE "/SEC
 3. _____

RA/TO Rawley / Groebner

Observatory Record Number 63819

FES___ Counts Out 397 In 214 Overlap Underlap Blindoffset
 Fast Slow

Reference
 Pnt. used:
 (if non-standard)

Tracking Mode FES___ + GYRO GYRO

Focus -2.06 FES___ Temp 2.4 BETA 37, 19, 59.2 X Y CT
 S/C ROLL 314, 10, 33

EXPO Start UT Day 119 Hr 00 Min 25 Sec 10 THDA in EXPO 10.2

READ Start UT Day 119 Hr 00 Min 46 LWR extended heater warmup/
 LWP bad scan starts _____

Archive Tape # 11002

IMAGE SEQUENCE NO. SWP 47567

EXPOSURE LEVELS

COMMENTS ON OBSERVATION

mission _____ DN, or _____ X OVER
 Continuum 185 DN, or _____ X OVER
 Background 15 DN, or _____ X OVER
 Noise 2 DN, Y _____

EX, EY = 0, 0

2MF missing
due to E5 drop
ILA < 350
NO REPLAY

11-7-93



Report Documentation Page

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16. Abstract This report summarizes the final results of an IUE investigation to search for signs of evolutionary changes in high-mass central stars of planetary nuclei, as evidenced by UV-optical fading over the lifetime of the satellite. The program is a continuation of an earlier investigation, expanding the target list to include more types of hot central stars and to obtain more spectra of previously observed stars. In order to compare the IUE fluxes of a central star obtained over a more-than-ten-year timespan, several steps were necessary, including reprocessing a very early spectra and correction for the sensitivity degradation of the SWP camera over time. The results indicate that while a few stars appear to have diminished UV fluxes compared to earlier IUE observations, the evidence for this is less than overwhelming due to the sparseness of the data. Those stars which emerge from this study as viable candidates for having faded are the cooler of-type stars (06f-07f), i.e., those for which the change in spectral energy with increasing temperature is greatest. The report describes the data analysis steps and discusses the uncertainties in both the data and in the resulting fading rates. Estimates of stellar mass based on theoretical evolutionary rates are also provided.					
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